consulting engineer

He Sticks to His Knitting

ALF KOLFLAT is senior partner at Sargent and Lundy, Chicago firm of engineering consultants which specializes in power plant design. Kolflat is sensitive to the responsibilities he has recently taken over in ascending to the senior partner's chair, but in talking with him one soon senses his firm, basic feeling that his organization is in no sense a "one-man" oper-

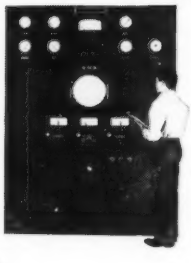
—Continued on page 8

June 1954

The Consulting Engineer's Professional Magazine

for the man considering a PACKAGE BOILER

new all-electric METERING TYPE PACKAGED CONTROL by HAYS



Now available for *all* makes and sizes of water tube type package boilers is the new all-electric, metering type Hays packaged control.

Metering type control provides maximum combustion efficiency regardless of the fuel burned because it *actually meters* the fuel flow and air flow, and automatically maintains the desired ratio. No adjustments are needed when changing fuels or oil burner tips.

All-electric operation includes not only safety devices but also steam, fuel, and air controllers and valves—uses only the normal source of AC voltage. No compressed air is required.

Fully automatic, safe and reliable operation is assured because Hays maintains the same industrial quality built into the largest utility combustion control system and it is factory tested before shipment.

Complete package in one simple and inexpensive to install panel board.

Write today for fact-filled Bulletin 53-1088-239.

THE **hays** CORPORATION

MICHIGAN CITY 32, INDIAN

Automatic Combustion Control • Veriflow Meters ar
Veritrol • Electronic Oxygen Recorders • CO_2 Recorde
Boiler Panels • Gas Analyzers • Combustion Test Se
Draft Gages • Electronic Flowmeters • Miniatu
Remote Indicators • Electronic Feed Water Contro

VOLUME 3
NUMBER 6

Published by Industry and Power Publications

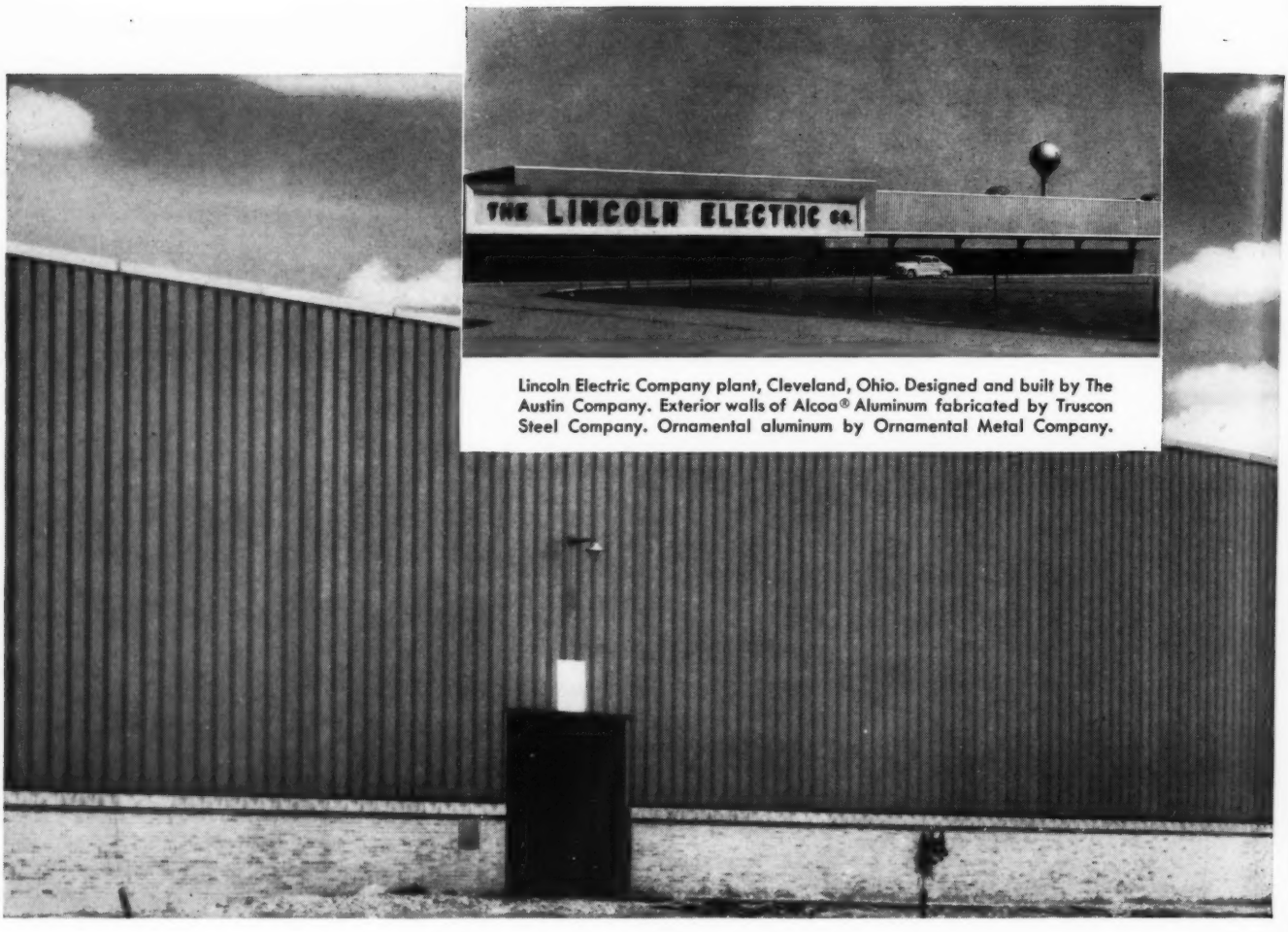
consulting engineer

JUNE 1954

FEATURES

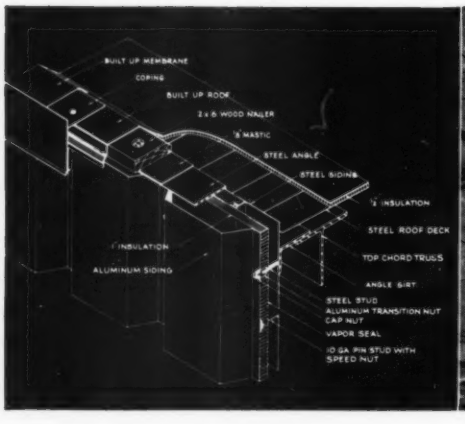
DEPARTMENTS

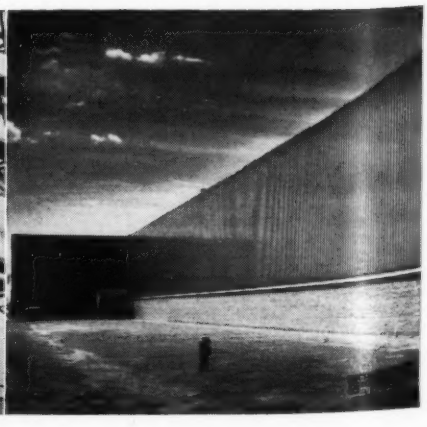
CONSULTING ENGINEER is published monthly at 420 Main St., St. Joseph, Mich. Subscription 1 year $5.00; outside U. S. price $10.00; single copy 50c. Acceptance under Section 34.64 P. L. & R. authorized by U. S. Post Office. Form 3547 requested.



Lincoln Electric Company plant, Cleveland, Ohio. Designed and built by The Austin Company. Exterior walls of Alcoa® Aluminum fabricated by Truscon Steel Company. Ornamental aluminum by Ornamental Metal Company.

BUILT TO SAVE MONEY

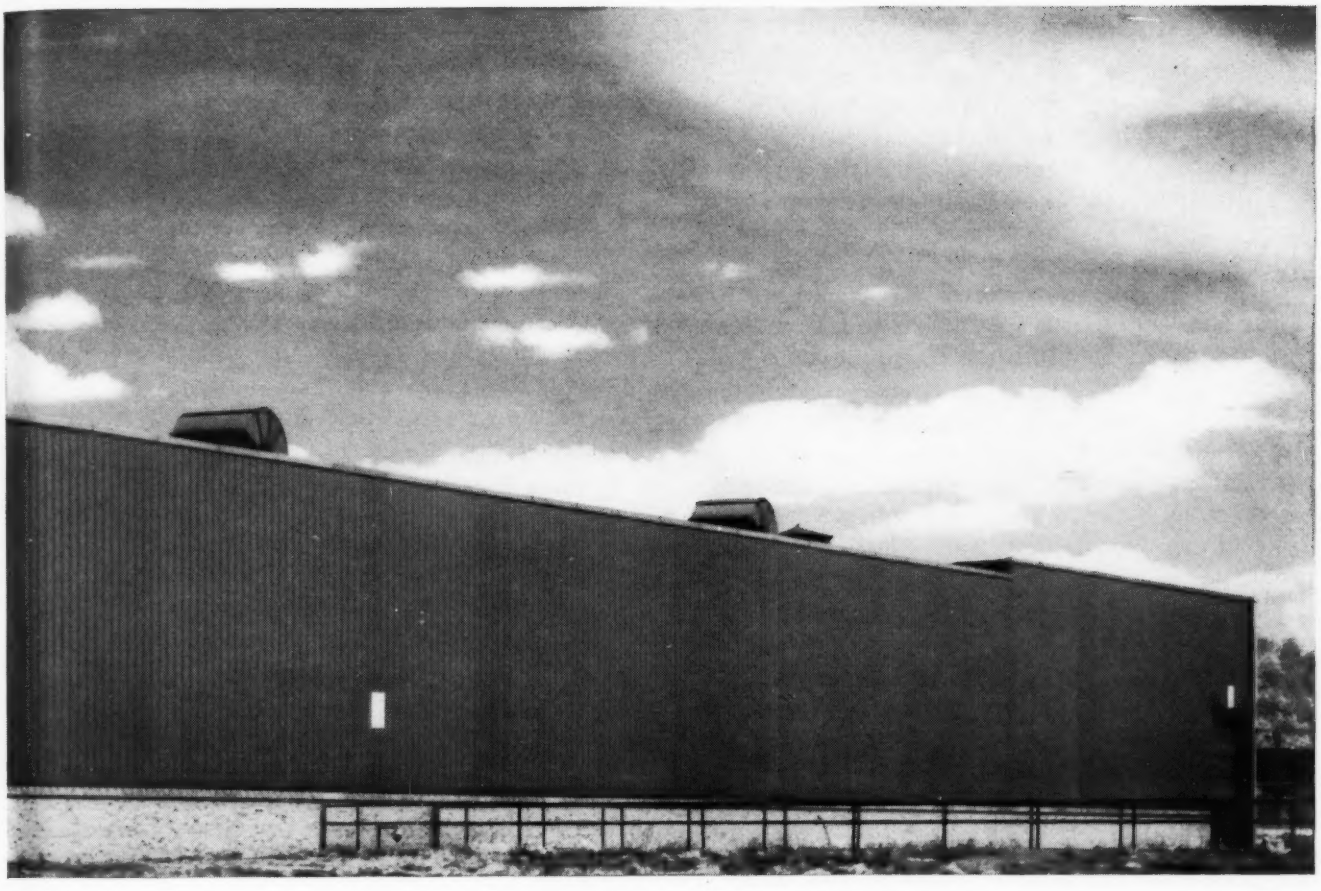




Detail of wall panel. Completed wall has heat-transfer coefficient of .25 BTU per sq ft, is 6¼ inches thick, weighs 3¾ lbs per sq ft. Compare with .50 BTU for 8 inch brick wall weighing 50 lbs per sq ft.

Speed clips over ten gauge, headless pins welded to inner wall hold fiber glass insulation in place. Aluminum exterior panel then is fastened to studs with aluminum transition and cap nuts.

Twenty-five foot, inner (Ferroboard) panels fit over studs fastened to girts at sill line and parallel to top and bottom chord of trusses. Fourth girt, carrying additional row of studs is arc welded to inner panel.



. . . Inside and Out

Dedicated to a policy of constant cost reduction, Lincoln Electric Company built a complete new plant designed to slash or eliminate materials handling storage, maintenance and other indirect production costs of manufacturing welding equipment.

Insulated, aluminum-faced panels were used for exterior walls because they were, "faster to put up, lower in cost for equal insulating value, require less maintenance."

Alcoa engineers worked with the builders of this plant as they have with the designers of nearly every pioneering use of aluminum in the building field. They will be glad to work with you. Nowhere else will you find so many men who know so much about aluminum. For information on any application of aluminum call your local Alcoa sales office or write: ALUMINUM COMPANY OF AMERICA, 1891-F Alcoa Bldg., Pittsburgh 19, Pa.

ALCOA ALUMINUM

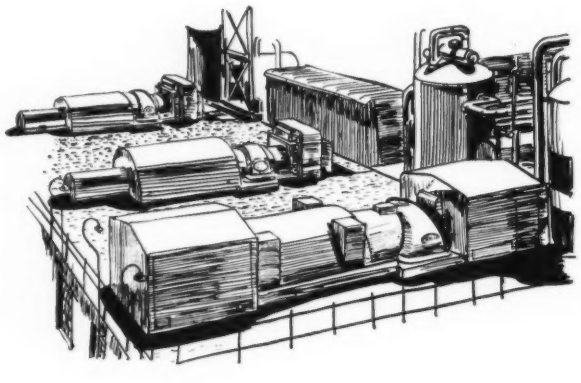
ALUMINUM COMPANY OF AMERICA

He Sticks to His Knitting

—Starts on Front Cover

ation nor is the leadership he presently holds the product of one man's strength. The ownership and leadership of the firm rests not solely with him, but in the hands of the active partners, all of whom are in participating charge of the company's projects.

Kolflat's own personality and thinking exemplifies the firm's policy. He is friendly, clear-eyed, reserved in speech, and steady in stature. He will tell you in definite terms how he feels about the ethics of engineering. In the matter of advertising, for example, he feels there is nothing wrong with a consulting firm telling that it has completed a project. It is all in how the story is told. If it is implied that only this firm could have done the job, or that they did the job better than anyone else could have, or if the presentation is in any sense self-laudatory, then the advertising has shaded to the nether side of engineering ethics.



However, Sargent and Lundy has up to now restricted its own advertising to professional card listings in a few well-known publications. As a well-established firm drawing its business on the basis of its performance, this has, Kolflat observed, been adequate in the past, but he acknowledges that changing conditions may require different and more aggressive methods.

In 28 years with Sargent and Lundy, Kolflat has seen many changes in the specialty of the house—the designs of electric power plants. Basically, there has been a tremendous improvement in plant economy mainly due to the radical increase in steam pressure and temperature, utilizing new and previously unknown materials. The driving forces in this development of high-economy plants have been the free exchange of information between utility companies, plus the continuous will of engineers, manufacturers, and utility personnel to always design the next plant better than the last.

Where do we go from here? Kolflat sees no end to the nation's increasing appetite for electric power. The long-range growth pattern shows an eight-percent rise in energy consumption every year. This means a full doubling every 10 or 11 years; after 40 years or so, this growth becomes phenomenal. The answer lies in atomic energy, as he sees it; there is no other way than to call on the atom to fill in for fossil fuels. As soon as the reactor plants become economically competitive, Kolflat feels that the sky will be the limit.

As the country grows, there will be more work for everyone. Kolflat recalls the good fortune Fred Sargent had in becoming associated with Samuel Insull's utilities and with Chicago's Columbian Exposition of 1893. These were the beginnings from which Sargent and Lundy grew. The coming of atomic energy may well prove similarly opportune. But Sargent and Lundy recognizes that atomic energy will not change the design of power plant elements as completely as may appear at first glance. Kolflat points out that turbines and generating equipment, pumps and fans, and many other mechanical and electrical items will remain much the same. The cumulative experiences and abilities developed in dealing with the power plant of today will retain their values when properly modified to the new requirements of the Atomic Age.

There is still a touch of the Norwegian in Kolflat's talk. He comes from a fishing village in Norway's Lofoten Islands above the Arctic Circle. He was born in 1896 and has seven brothers and two sisters. His interests soon went beyond his father's general store and the bit of dairy farming the family did. After picking up his basic engineering education in Norway, he thought of the United States and decided this was a place he had to see for himself.

After coming to this country, Kolflat worked for Armstrong Cork and West Penn Power. He married his sweetheart from Norway, promptly applied for a new job with a firm he had never heard of before—Sargent and Lundy of Chicago. The rest is strictly a story of success; he started in the mechanical engineering department, "stuck to his knitting," and rose to become the firm's chief executive. To this day, his conversation is peppered with his favorite phrase: "stick to your knitting."

He'll tell you that there is "a lot of dish-washing" in any business. His success, and the success of the firm, comes from sticking to one's knitting, from doing an honest day's work every working day, from promoting from within so that prior observations can be relied on to predict future performance of those on the way up, and from emphasizing integrity as a matter of active policy. Kolflat believes that the basis of ethics in engineering is integrity; certainly his career proves that success and integrity are handsome companions. ▲▲

NOW BARK HAS LOST ITS BITE

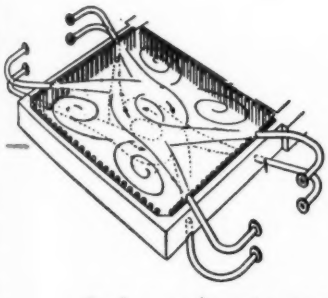
There is no doubt about it — the disposal of bark has always posed a serious problem, particularly to the paper pulp and lumber industries. Bulky, dirty, and moisture-laden, this ever-present waste material accumulates in veritable mountains at many mills and has generally been regarded as a headache.

Sure — it can be burned and — until recently — has been, in cumbersome dutch oven furnaces with much difficulty and inefficiency.

Now — with the availability of the C-E Bark-Burning Unit — "bark has lost its bite." The secret is turbulent, suspension burning as illustrated on the opposite page and described below.

This eminently successful unit is but another in a growing list of C-E developments which have solved difficult problems in the field of fuel burning and steam generation. Outstanding improvements in the methods of burning bagasse, furfural residue, black liquor and lignite, as well as the easy disposal of sewage and industrial wastes — to mention but a few — have not only proved practical but highly profitable.

So if you burn bark, waste wood or other cellulose fuel, investigate the exceptional advantages of the C-E Bark-Burning Unit. Operating installations in various parts of the country are demonstrating its exceptional reliability and efficiency day after day, month in and month out. The experience and engineering competence of the C-E staff are freely available to you and your consultants.



HERE'S HOW IT WORKS...

Bark, wood waste, or other cellulose fuel is introduced into the furnace by special spreader units located considerably above grate level. At the same time, extreme turbulence is produced in the furnace by blowing tangentially directed streams of preheated air through rows of nozzles at various furnace levels as shown in the sketch above. On each alternate level the tangential action is in the opposite direction.

Thus the fuel is fed into a zone of violently swirling air, preheated to a temperature of several hundred degrees. Under these circumstances, moisture evaporates almost instantly — and nearly all of the flash-dried fuel burns in suspension. The remainder falls to the grate in an even layer, where it is quickly consumed.

Both Eastern and Western waste woods are being burned with complete satisfaction by this Combustion equipment, and at substantial savings over any previous method.

B-747

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

READERS' COMMENT

Free-Pistons Again

Sir:

I am very interested in the free-piston engine, and understand an article appeared on this development in your journal for August, 1953 on p. 26. If at all possible I should like to obtain a copy of this paper, and would appreciate any assistance you can give me in this matter.

C. M. Gray
Senior Representative
Commonwealth of Australia
Strand, London

Sir:

If tear sheets are available, I would appreciate copy of article on the free-piston engine which was published in the August 1953 issue.

My attention was called to this subject by the Arthur Little Industrial Bulletin.

Adah Lee
Member of Staff
The Brookings Institution
Washington 6, D. C.

NSPE Article

Sir:

Thank you very much for . . . . the article on NSPE which appeared in the current issue of CONSULTING ENGINEER. This certainly is a fine presentation and I am sure will prove of interest to many members of the engineering profession.

Paul H. Robbins, P. E.
Executive Director
National Society of Professional Engineers
Washington 5, D. C.

Need Books?

Sir:

At the present time I'm doing the surveying and drafting on a transmission line and I would like to purchase a book on "Transmission Lines" — design, construction, maintenance, etc. I would like the book to contain material on computing the sag curve for various span lengths. I would also like to get material in drawing up typical crossings at roads, railroads, other electrical lines.

Edward Charles
South Range, Michigan

• BOOK REVIEW EDITOR SUPPLIED LIST OF BOOKS ON THE SUBJECT—ED.

CE Binders

Sir:

Enclosed is $3.00 check for CONSULTING ENGINEER binder advertised in April 1954, and request for 1953 issues of January to July inclusive. (Also December '52 if possible.) Please note, I do not have issues requested, and they would be necessary to complete binder.

Herbert Argintar, P. E.
New York 36, New York

• BINDERS AND MOST *1953* ISSUES STILL AVAILABLE—ED.

Plant Site Selection

Sir:

Your March, 1954 issue of CONSULTING ENGINEER has an excellent article on the matter of Site Selection for Industry. Reference is made to the "Manual for Community Economic Development" put out by the Public Utilities Association of Virginia.

I would appreciate it if you would let me know the address to which I might write to secure copies of this manual.

A. R. Eckberg, Manager
Eastman Kodak Company
Rochester 4, New York

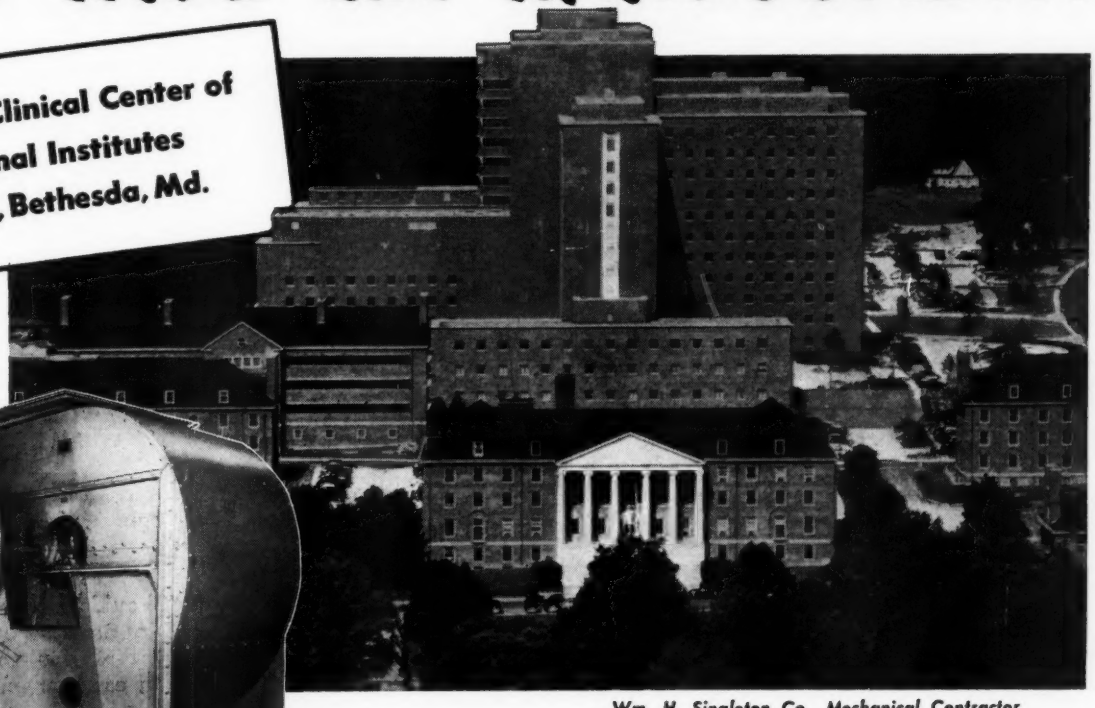
• WRITE AREA DEVELOPMENT COMMITTEE, PUBLIC UTILITIES ASSOCIATION OF THE VIRGINIAS, 5 FRANKLIN ROAD, ROANOKE *11*, VIRGINIA—ED.

Sir:

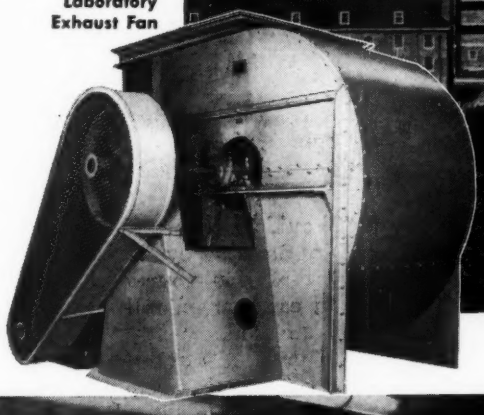
I was particularly pleased to receive a copy of the March issue of your magazine, CONSULTING ENGINEER from Gayle Arnold, who is

HIGH, WIDE and HANDSOME...

The New Clinical Center of the National Institutes of Health, Bethesda, Md.

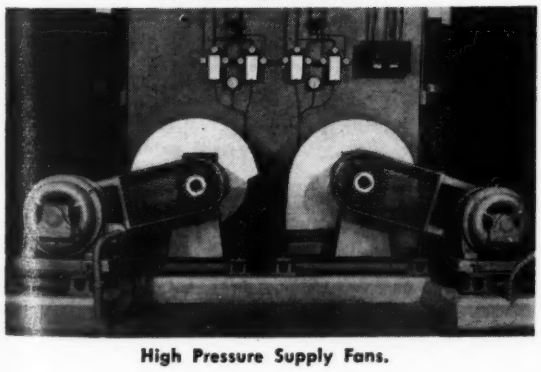


Lead-Lined Laboratory Exhaust Fan



Wm. H. Singleton Co., Mechanical Contractor

The Complete Air Conditioning System Serves Spacious Sunrooms On Each Floor.



High Pressure Supply Fans.

Where Each Doctor, Scientist, and Patient is SPECIALLY SELECTED

AIR-HANDLING EQUIPMENT by Bayley

Representing an investment of approximately 64 millions of dollars, great care has been taken to provide the very finest in construction, facilities, and equipment in the new Clinical Center at the U.S. Public Health Service at Bethesda, Md. Admission is restricted to patients selected for treatment and research for certain diseases.

We take exceptional pride in having been chosen to furnish the specially designed Fan equipment for the extensive and intricate air handling system serving this great health establishment.

Bayley

BLOWER COMPANY

Engineered Air-Handling Equipment

6610 W. BURNHAM STREET • MILWAUKEE 14, WISCONSIN

a very active and valued member of the Institute's Industrial Council, and to read his excellent article, "They're Out to Get You." I want to call the attention of our membership to this article in *Urban Land*, our monthly news bulletin.

I should also like permission to quote extracts from the very interesting article on passenger conveyor systems by Paul W. Freitag, Jr., appearing in the same issue. Its implications with reference to the potential effect of this development on shopping centers and other urban land uses is of considerable interest to us.

Max S. Wehrly,
Executive Director
The Urban Land Institute
Washington 6, D. C.

Regulators or Capacitors

Sir:

Any tear sheets of the article, "Should You Specify Regulators or Capacitors?" by R. D. Okerberg, appearing in your April issue, that you can conveniently spare, will be appreciated.

Thanks for any help you can give us in this request.

H. C. Brunner
Advertising and Industrial Press Dept.
Allis-Chalmers Manufacturing Co.
Milwaukee 1, Wisconsin

•WE ARE GLAD TO SUPPLY READERS WITH TEAR SHEETS—OR REPRINTS OF ARTICLES FROM PAST ISSUES — ED.

Would Reprint

Sir:

We are interested in reprinting the very excellent article by Joseph G. Conrath on page 31 of your February 1954 issue on our work on the Sixth Street Viaduct in Erie, Pennsylvania.

John C. King, Chief Engineer
Intrusion-Prepakt, Inc.
Cleveland 14, Ohio

Social Security

Sir:

While reading through the April 1954 issue of CONSULTING ENGINEER I came across the article "How Will the New Social Security Act Affect Engineers?" by W. B. Fingal, Washington Correspondent. I know this article would be of great interest to my Congressman and State Representative.

Would it be possible for you to send me two reprints of this article?

Arthur E. Fryer, Adm. Sec'y.
American Material Handling Society, Inc.
Toledo 12, Ohio

THE MOST IMPORTANT LINE IN AMERICA

It's America's lifeline, really – the power line that starts with steam and brings heat, light, and energy to the nation's factories, farms, homes, and stores. Paralleling that line is the line of cost; if that didn't go down, the power line might.

Power costs have declined steadily since 1881, when Thomas A. Edison opened the nation's first electric generating station and B&W, who supplied his boilers, embarked on a fruitful, continuing search for better and better ways to generate steam and to harness more and more usable energy from the fuel consumed.

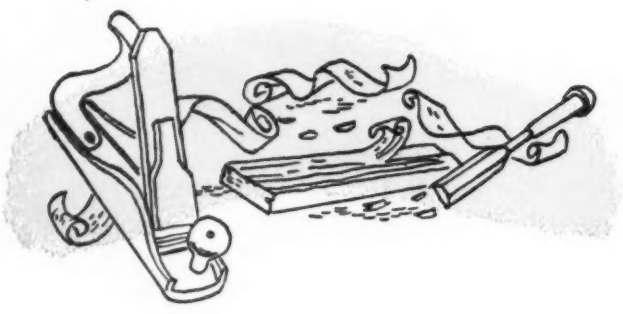
Economical, dependable service is the watchword of America's Electric Companies. The chart reflects how well their all-important job is being done. And to help insure that electricity will remain America's best bargain, B&W Research and Engineering dedicates men, money and machines to continuing progress in steam and fuel technology.

Light's Diamond Jubilee
Light for Freedom – Power for Progress

BABCOCK & WILCOX

BOILER DIVISION

N-183



SCRAP & SHAVINGS

The April issue of CONSULTING ENGINEER carried as its lead article an exclusive story entitled "How Will the New Social Security Act Affect Engineers." When we ran the story there was some feeling that its publication might be premature or even unnecessary, for it is hard to predict just what Congress will do several months ahead. Our editorial judgment proved to be correct in this instance, for headlines in the newspapers have announced that the House Ways and Means Committee has voted to bring professional men under the Act. The news stories, as might be expected, emphasized the fact that lawyers and others would come under Social Security legislation, but little mention was made of engineers in private practice. Such engineers *are* included.

There has been considerable opposition to bringing professional men under Social Security. The opposition has been led by the American Medical Association, the American Bar Association, and the National Society of Professional Engineers. During the past year, however, the Bar Association has backed up slightly. Some local bar associations have even gone on record as favoring inclusion.

The opposition to coverage is largely based on the "earnings test." Currently, any retired worker who makes over $75 a month is ineligible for old age benefits for that month. Obviously, no man wants to pay a sizable percentage of his income into a fund only to have his payments denied because he is able to make a little money after his retirement. Most professional men do find an opportunity to engage in occasional consulting work after they have officially retired, and they would get nothing back for all their payments if their earnings amounted to more than that $75 a month.

However, with every revision of the Act, the trend has been toward liberalizing this figure for allowable earnings. The current bill undoubtedly will allow either $1000 a year or $100 a month. It is possible that in the future the "earnings test" will be removed entirely. There is backing for such legislation now. If the test were removed, there would be every reason for professional men to want to be included under Social Security.

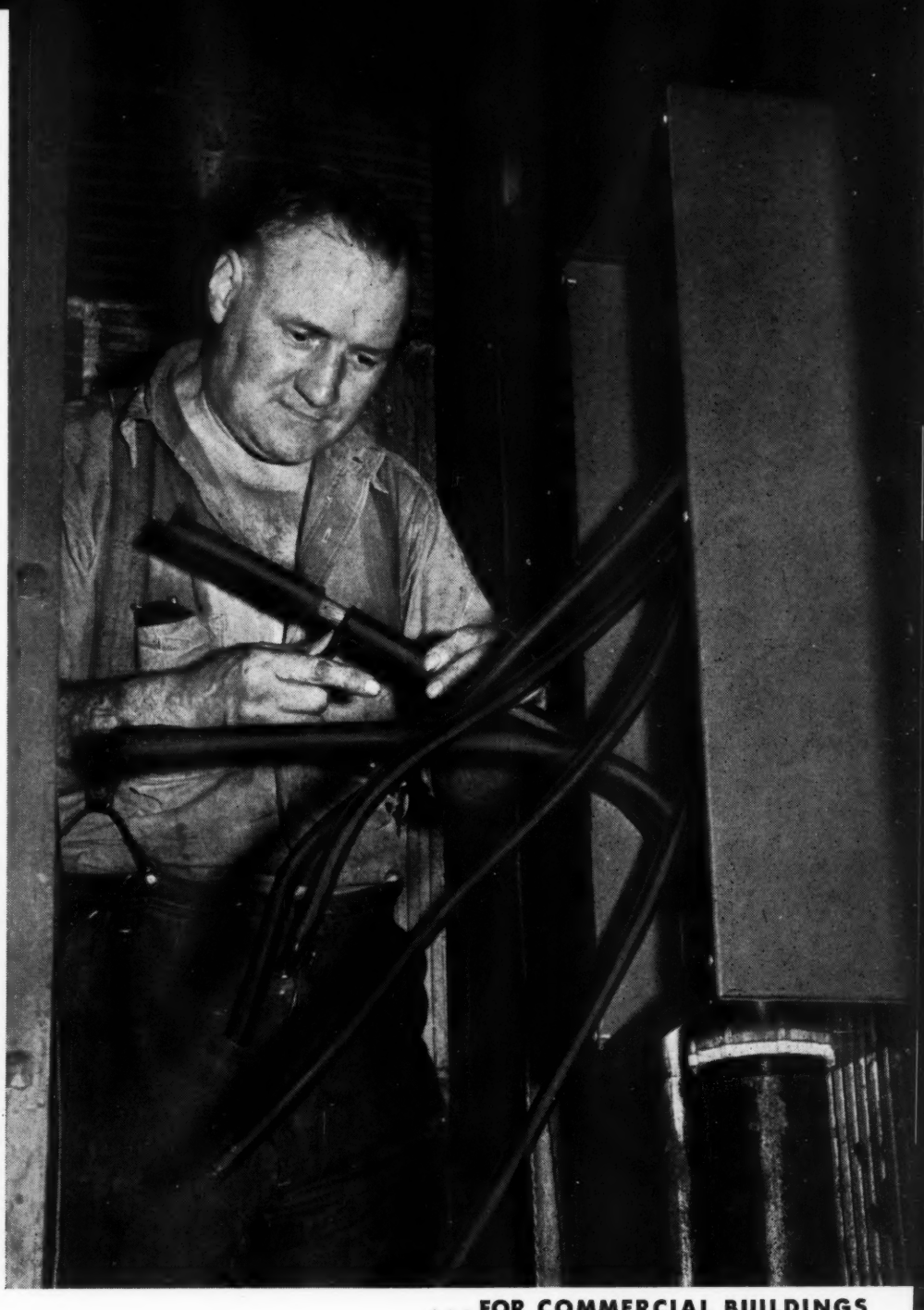
The basic question for future legislation to decide is whether the old age benefits are paid only to the needy or are paid as part of a universal insurance program—where the well-to-do as well as the needy get back an annuity in return for premiums paid. Current thinking is heavily in favor of "insurance" as opposed to "relief" as the proper philosophy for old age benefits under Social Security.

We think the "insurance" idea is the right one. As a practical matter it will be much to the advantage of the professional man—but it is the logical and sound approach even if it did not benefit us. There is no need for the stigma of "relief" to be attached to payments taken from funds paid in by the recipient himself. There is also no logic in denying the financially successful man a right to a return from his investment in Social Security merely because he has been successful.

It has been pointed out that universal payments without an "earnings test" would necessitate an increase in monthly payments into the fund. On the other hand, it has also been pointed out that increased coverage—the inclusion of more people under the Act—should decrease total costs as in any insurance operation, and furthermore, if everyone automatically received payments at 65 years of age, there would be no need for the great cost currently incurred in investigation of eligibility. More expensive or not, it is only reasonable to prefer some return on a larger investment to total loss on a smaller one.

Assuming that the new bill gets successfully through both Houses of Congress, as would seem certain now, engineers in private practice will probably start paying Social Security taxes next January. The actual handling of the papers and the making of the returns will not be too burdensome after the first few months, and the procedure will soon become routine.

The next step should be a concerted effort by all professional groups to convince Congress that the "earnings tests" should be removed. No doubt the American Bar Association, the American Medical Association, and the National Society of Professional Engineers are already putting this on their agenda. A letter to the NSPE would be in order, for they are always interested in their members' opinions in order that they may properly represent the general will of the profession. ▲▲



...FOR UTILITIES

...FOR COMMERCIAL BUILDINGS

than you now pay

the cheapest cable or a premium cable like neoprene-jacketed Durasheath*.

But what a difference there can be in performance!

Anaconda's Durasheath is tough ... heat-resistant ... long-lasting. Its rugged neoprene jacket resists moisture, chemicals, sunlight, corrosion, electrolysis, abrasion and mechanical injury. It delivers real service dependability year after year.

And Durasheath is good for almost any job you have. You can bury it directly in the ground ... run it in damp ducts ... string it overhead ... in *one continuous run* with minimum splicing. Order through your Anaconda Sales Office or distributor. *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

*Reg. U. S. Pat. Off. 54386

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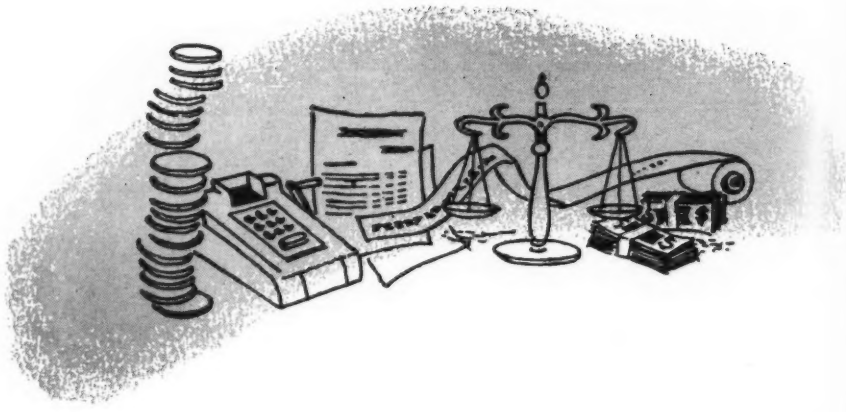
Primary and secondary distribution cable • building wire • portable cords and cables • mine cable • magnet wire • copper, aluminum, copperweld conductors • signal, control and communication wire • wire and cable accessories.

ECONOMIC NEWS NOTES

E. J. Mac Donald
INDUSTRIAL ECONOMIST

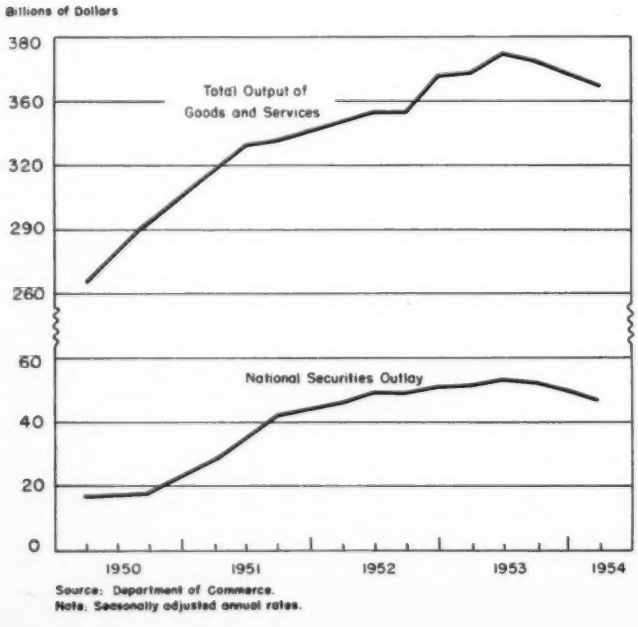


TAX IMPROVEMENT—The Senate Finance Committee has approved the House provision permitting business firms to either deduct or capitalize research and development expenditures. Under this provision companies could write off these costs as incurred or treat them as deferred expenses to be written off in five or more years.

RECOMMENDED READING—The announcement of plans for leasing industrial equipment by one firm after another reflects the growing importance of the lease device. An excellent report on the subject, "Leasing of Industrial Equipment," has been published by the Council for Technological Advancement, Chicago. Covering such subjects as advantages and disadvantages of leasing, analysis of terms and conditions of leases, and legal and tax problems, this is a study well worth reading.

KEY STATEMENT—Secretary of Defense Wilson's statement last month that recent developments in Asia and Europe may "force a soul-searching review of our [military] expenditures," indicates that the influence on the economy of one of the principal factors in the 1953-54 decline in business activity (see chart) might be considerably different in the last half of this year.

DUE TO TURN UP AGAIN?



Source: Department of Commerce.
Note. Seasonally adjusted annual rates.

ALWAYS LOOKING—The search for new plant sites is pretty much of a continuous process of du Pont's. An article in the March-April issue of **Industrial Development** spells out the selection technique of du Pont's plant-site team. Major factors listed as used in making detailed cost comparisons include materials, electricity, labor, transportation, and overhead expenses.

THREE ALARMS—A seemingly anomalous feature of the advance of civilization is new fire hazards. In a recent speech, Mr. L. A. Vincent, general manager of the National Board of Fire Underwriters, referred to excessive area buildings and to "industrial fire and explosive hazards that are finding their way into processes formerly considered almost inert." He pointed out also that the windowless building has complicated fire fighting and rescue operations and that there has been a "trend toward the establishment of large industrial and mercantile buildings in small communities that cannot be expected to have the municipal fire protection needed for such properties."

GROWTH INDUSTRY — Electronics, along with chemicals, will be among our fastest growing industries over the next two decades, predicts Mr. A. T. Colwell, vice president of Thompson Products, Inc. Speaking to the National Federation of Financial Analysts, he pointed out that competitive pressures will force industry in general to expend increasing amounts for electronic equipment.

NO OVERNIGHT CHANGES—The same audience was told by Mr. E. H. Scott, comptroller of Detroit Edison, that forced obsolescence of the utility industry's plant and equipment is not likely to be an immediate consequence of the introduction of atomic power. He expects nuclear power producing facilities to be put on line in an orderly schedule.

REMARK OF THE MONTH—"The thing that is really new in our world is the swiftness of the impact of the change and the multiplying sources from which change can come." Mr. B. Torrence, vice president of City Bank & Trust, N.Y.

NOW AVAILABLE—A new, 92-page Government purchasing directory, the first complete guide to military and civilian purchasing activities of the Government, has been published by the Small Business Administration. Listed are 4000 categories of items with names and addresses of agencies and offices buying them. Fifty cents at Government Printing Office, Washington 25, D. C.

at Detroit's
NORTHLAND PROJECT

vital energy for a shopping wonderland
supplied by I-T-E dry-type, double-ended Unit Substations

Eleven I-T-E metal-enclosed Unit Substations, rated 1500 and 2000 kva, service the Center's immense lighting and power requirements. And to assure service continuity, Northland's electrical system features I-T-E Selective Tripping devices on the circuit breakers, which *isolate* system faults by interrupting only the circuit nearest the fault.

From the start, important engineering aid was given Northland by I-T-E application engineers. Thanks to this close cooperation, power distribution equipment was on hand *when needed* to fit right in with tight construction schedules.

I-T-E is proud of its place as a *major* contributor of quality power distribution equipment for the "world's largest shopping center."

AT NORTHLAND—
I-T-E Substations service:

interior lighting	**escalators**
exterior lighting	**pumps & blowers**
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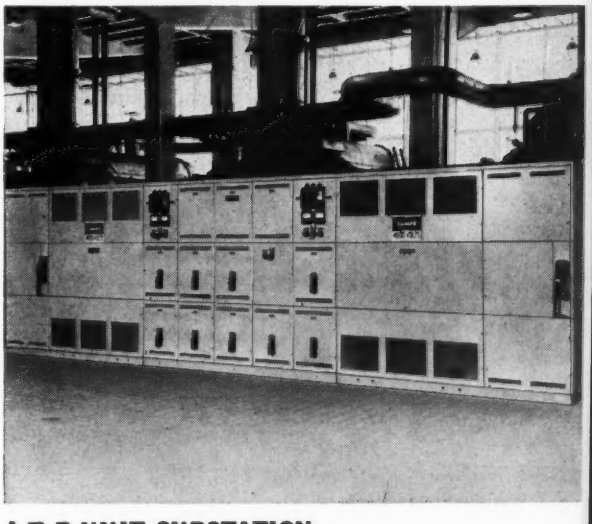

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RENTING A REACTOR is now possible. Certain experimental facilities of the Materials Testing Reactor at the National Reactor Testing Station in Idaho have been opened to the public on a limited basis for private research. Anyone interested should contact the AEC's contractor -- the Phillips Petroleum Company, Idaho Falls, Idaho. And those interested in canned electric-motor-driven pumps developed for the AEC can get complete descriptions (including photographs, cut-a-way illustrations, flow diagrams, and color sectional views) of units produced by Westinghouse, Allis-Chalmers and Byron-Jackson; write to the AEC Pittsburgh Area Office, Bettis Plant, P. O. Box 1105, Pittsburgh, Pa.

THE JOINT Congressional Committee on Atomic Energy has been hearing testimony on the proposed changes to the Atomic Energy Act of 1946. The principal concern of the Committee has been with the several matters as reported here in previous months. But a very interesting, new twist came up during the testimony of Karl P. Cohen, vice president of Walter Kidde Nuclear Laboratories: ". . . We are not developing the proper kind of atomic industry now . . . . . It is a gross misreading of economic history to believe that a whole new industry can be created by a mere extension of the activities of existing enterprises, to whom atomic energy is a side-issue. Yet the major share of the development of atomic power now is either in the hands of government laboratories, or subsidized giant corporations whose profit-making interests lie outside the atomic energy field. (It has been tacitly assumed) that competition in the atomic energy field will be furnished only by existing companies. I believe it will be new companies which will furnish the competition . . . "

THE ARRIVAL of atomic power on a commercially feasible basis is continuing to be heralded. Responsible people have now come out and publicly stated that an atomic power plant will certainly generate electricity at competitive cost within 10 years. This unit will probably have a boiling water reactor, using light water as a coolant and as the moderator. The water would be boiled inside the reactor, directly producing radioactive steam to power a turbine. This reactor is most like present utility plants in that no unique coolants are required; in addition, there are advantages in that there are no chemical separations plants needed, safety factors are such that plant sites could be selected within existing utility systems, and the period between fuel rechargings is comparatively long.

OPTIMISTIC as the previous paragraph sounds, a crash program for accelerating the reactor development program has been called for by one of President Eisenhower's military advisors. In what has been labeled a "trial balloon," Robert LeBaron calls for telescoping development of a practical atom power plant into only five years, instead of ten. He also says "The advent of commercial atomic power will be a great force for decentralization of industry . . . . (it) has within itself the direct antidote for the destructive forces of the military atom (against concentrated targets)."

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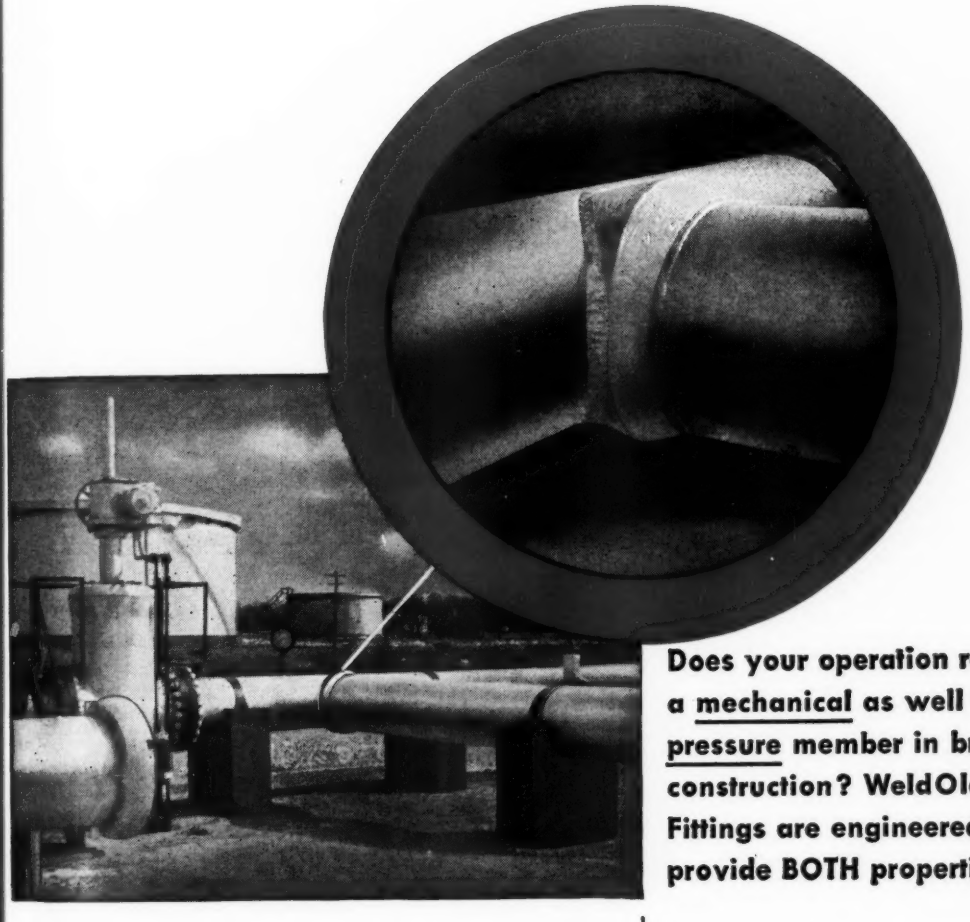

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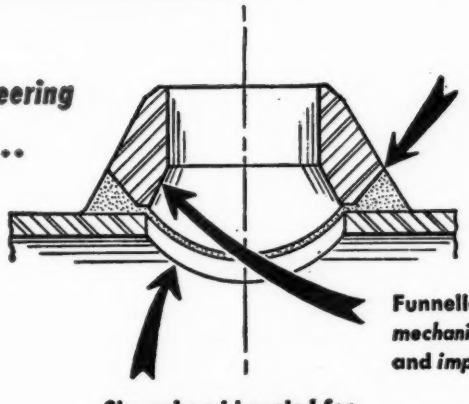

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Department of Business and Economics

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EFFICIENT PRODUCTION is a matter not only of machinery and methods, but of personnel. The aim of promoting labor efficiency is reflected in a wide variety of modern industrial practices; an early developed and important one of these techniques is the incentive wage.

Incentive wage rate structures are founded on the belief that employees should be compensated, where circumstances permit, on the basis not only of time put in at the job but of output. The use of such wage rates was advocated by Frederick W. Taylor, a pioneer in the field of "scientific management", as a deterrent to what he called "systematic soldiering" by employees. Modern incentive plans, of which there are several types, represent modifications of the earlier systems, modifications designed to achieve effectiveness of administration and acceptability to labor.

Incentive wage payments make sense only where there is a clear and precise relation between an employee's effort and his output. Hence they can be applied to good advantage only where productive operations are highly standardized and essentially repetitive. They are of little value if bottlenecks in materials or frequent machine breakdowns make production irregular for reasons that the workers themselves can in no way control.

Moreover, output must be easily measurable. Thus, uniformity of product is prerequisite for the adoption of an incentive plan. Where each unit of output must be made to special specifications, or where a single unit requires a considerable time in production, incentive plans, as a rule, are inappropriate. Another prerequisite is an effective system of quality control, without which speed may be gained at the cost of quality deterioration.

Finally, in operations using extremely valuable raw material or delicate equipment, incentive plans should be instituted only with great caution if at all. Advantages in speed may be more than offset by loss through spoilage.

The use of incentives is common practice in a number of manufacturing industries, including apparel, textile, footwear, and some metal working processes. In many other industries, practice is less uniform, but incentive rates do occur with some frequency.

In situations where the individual employee's contribution to output cannot be measured easily, group incentive plans are sometimes adopted. In such plans each worker shares, either equally or in proportion to his hourly rate, in bonuses for extra or sustained effort. Industrial engineers usually believe that where individual incentives are feasible they are preferable to group plans.

The key to any incentive wage plan is the production standards incorporated in it; that is, the outputs considered standard for experienced employees of average ability under normal conditions.

Three steps are typically involved in arriving at these standards. First comes an analysis of the methods and motions used in the operation in question. The equipment to be used and its placement and arrangement are subjected to scrutiny. Where feasible, alternative production methods are considered in this connection. Once the physical setup is determined, a detailed examination is made of the component parts of the job operation and the movements used by the operator. The study needed to achieve this may in itself suggest ways of improving efficiency of performance.

On the basis of the methods and motions analysis, the procedure for the job is standardized. After this step, it is necessary to select and train a number of pilot operators.

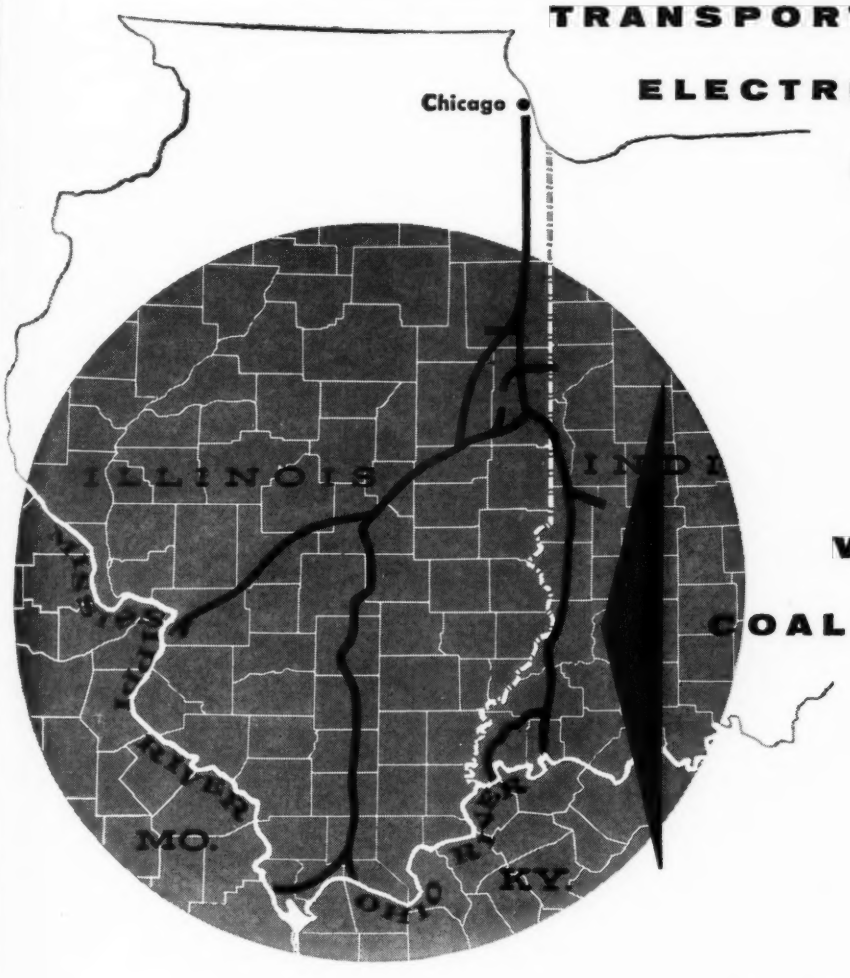
The final step is the determination of the time re-

quired for the job. In most instances, this time is arrived at by breaking the total process down into many small elements. The time required for each element is observed over a number of test performances and the average time is computed. Totalling the periods, and adding appropriate allowances for such factors as rest periods and cleanup times required for each element, the time for the entire operation may be quickly derived.

In some cases standard data on work elements are available from studies of other jobs, in other plants, and at previous times. Where sufficient data are at hand, these data may be used to eliminate the need for direct time studies or — if this is not desired — as a check against the observed time studies made.

One point should be emphasized. In spite of the apparent objectivity and scientific approach of the method outlined, there is a considerable element of human judgment involved in the process. It all boils down to the fact that someone has to decide who is the average worker and what are normal production conditions. Someone also has to decide whether the employee observed is working at his regular speed. The precision of the process of setting production standards is thus more apparent than real; skillful and competent analysts may arrive at considerably different times for the same operation by virtue of differences in their appraisals of normal pace and normal conditions. However, present day methods are certainly an advance over the rough estimates by foremen and supervisors that formerly were used in setting standards.

Though incentive plans in use today vary considerably in detail, for the most part they may be divided into two categories; piecework plans, and production bonus plans. Both plans commonly employ an hourly wage rate as a base. If an incentive system is being introduced for the first time, it is well to study the structure of hourly rates, adjusting it where necessary for equity and rationality, before determining the incentive rates. Both piecework and production bonus plans commonly



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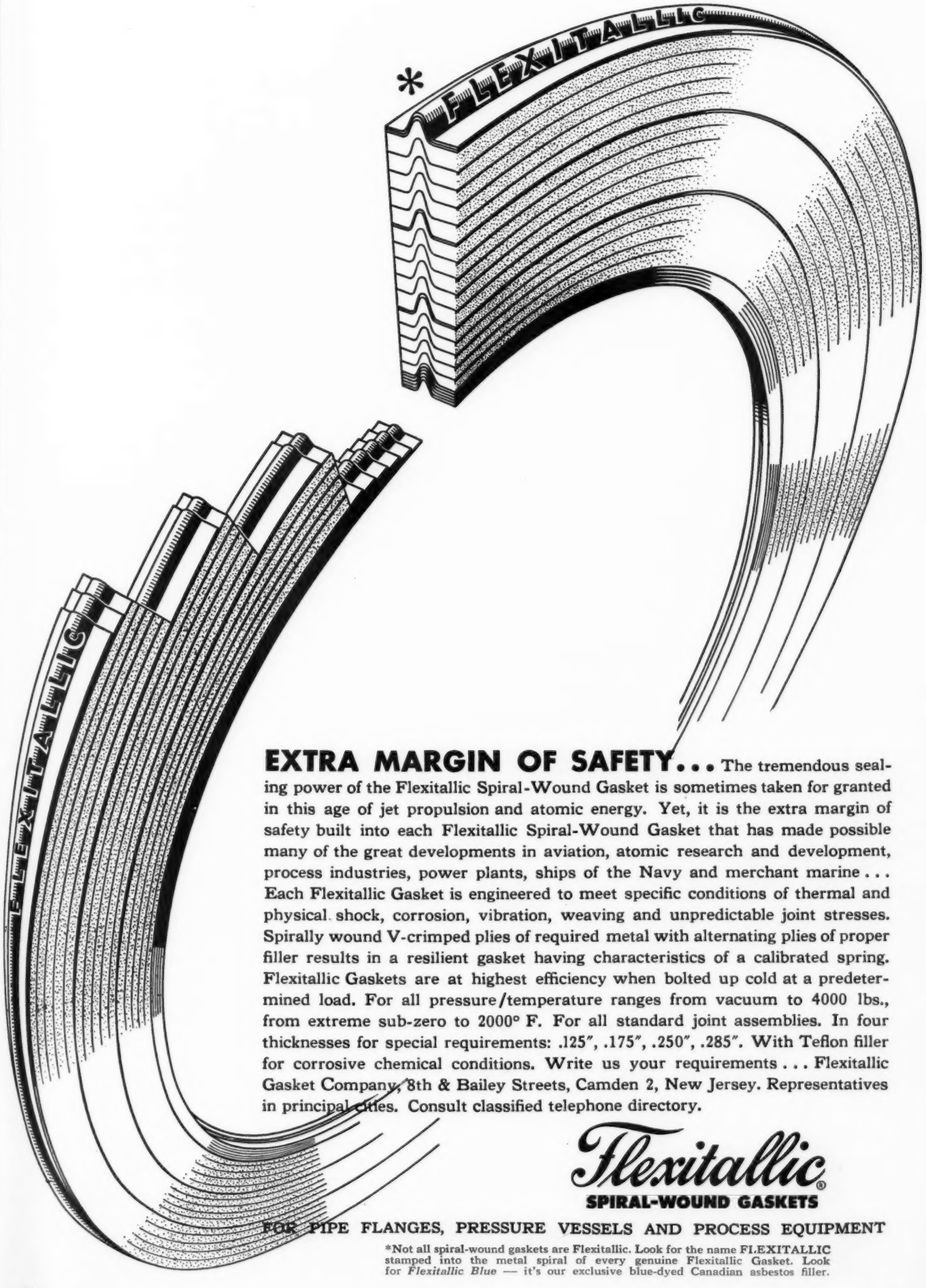
make use of what is called a premium or bonus factor; that is, in computing the rate for an operation the standard production time is increased by a factor typically around one-fourth. Such a premium widens the spread between the rates for standard and extra output. It is thought to enhance the incentive character of this type of plan.

The essential distinction between the two basic types of plans, as well as the nature of each, may be illustrated with an example. Let us suppose that a base rate of $1.20 an hour is used, and let us consider an operation for which the standard time is 0.8 minutes. If a bonus factor of one-fourth is used, this time will be increased to one minute. If piece rates are utilized, the piece rate in this case will be 2 cents — $1.20 divided by 60. In a production bonus plan, on the other hand, the employee is credited with 1 minute of production time for each unit of output he produces. At the end of the payroll period, he is then paid on the basis of the number of earned hours, computed in this way, that he has accrued.

In the examples given, an employee's wages increase in direct proportion to his productivity. Modern authorities believe that this feature is essential to a good incentive plan. They hold that systems in which rates fall with increased output, so that the employee does not receive the full reward for improved performance, disturb morale and sacrifice the incentive effect of the plans.

For many years unions were virtually unanimous in their vigorous opposition to incentive systems. The stop watch was widely regarded by workers as a baleful influence, tending to promote "speed ups" from which they would reap little or no good in the long run. In recent times, there has been some change in organized labor's attitude on this matter. While some unions continue to be antagonistic toward incentive wages, others have accepted the idea.

Some changes in labor's views on incentives may be traced to changes in the design of incentive systems. In years past it was quite common to find incentive plans of "decreasing cost" type, paying



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lower piece rates as productivity increased. Such plans have long appeared inequitable to workers. Frequent revisions of production standards and of established rates also created the impression that incentive plans were a device to increase the rate of production without benefiting the employees.

Modern authorities insist that incentive plans should be formulated so as to eliminate grounds for such charges. Thus they frown on "decreasing cost" plans. They urge also that changes in production standards should occur only when there has been a change in methods, equipment, materials, or product sufficient to bring about a clear change in production times. Changing standards simply because wages are getting too high is bad incentive practice.

Another feature increasing the acceptability of modern plans to labor is a guaranteed hourly base rate. Such a "floor" on earnings offers the employee assurance that his pay will not be cut below the minimum guarantee because of material shortages or machine failures. Guaranteed base earnings place on management the responsibility for guarding against production interruptions and also for hiring and retaining only capable employees.

Labor's historical distrust of incentive wages makes it particularly important that any plan adopted should be clearly understood by employees. Definite instructions as to policy and methods should be provided. Quality standards should also be defined.

Almost a third of the collective bargaining contracts in manufacturing mention incentive systems. A few contracts ban incentives entirely; another relatively small group of contracts, notably in the apparel industries, call for union-management formulation of incentive rates. The majority of the contracts, however, provide that management shall have first responsibility for setting new rates. Rates may, however, be taken up in the grievance procedure established by the contract. Union leaders who accept incentives in principle usually insist that contracts should provide some union participation in the formulation and administration of the plan. ▲▲

the Legal Aspect

MELVIN NORD

Consultant in Legal and Technical Problems
Registered Professional Engineer
Chemical Engineer
Patent Attorney

IN APRIL we discussed the elements necessary for the formation of a contract,—agreement and consideration. In May, we discussed the offer, and here we consider the acceptance of the offer.

The acceptance is needed in order to provide the agreement between parties. It is also normally the way in which the accepting party gives the necessary consideration,—either by doing the required act or by making the required promise. When the acceptance is by making a promise, it is not necessary that specific words of promise be used, as the promise will be implied from words such as, "I accept" or any similar phrase.

It is frequently stated that the offeree must intend to accept,—that there must be "reality of consent". This is not strictly true, since all that is required by the objective rule of contracts is a manifestation of assent. A secret intention not to accept will not suffice to prevent a contract from arising. However, where the words or acts of the offeree are ambiguous, his subjective intention not to accept will prevent a contract from arising.

One of the most important requirements of an acceptance is that it must be unconditional and unqualified. The offeree cannot pick and choose which parts of the offer he wishes to accept,—he must "take it or leave it" as a whole. If he does not accept fully, but adds qualifications to the offer, his reply will not be regarded as an acceptance of the offer. In fact it will be a rejection, coupled with a counter-offer of his own. This does not, of course, apply when the "qualification" is immaterial, i. e. when it would be implied anyhow from the offer. Nor does this imply that any statement by the offeree which does not accept the offer will necessarily be a rejection. It is quite possible for the offeree to make some "neutral" remarks or suggestions which neither accept nor reject the offer.

If the offer asks for acceptance by an act, promising to do the act will not suffice. If the offer asks for a promise, starting to do the act will not be an acceptance unless it unequivocally implies a promise to complete the act. Of course, if the offeree completes the act in time, this will imply the required promise to do the act,—so there will be acceptance of the offer.

If the offeree is silent upon receiving the offer, this silence may be ambiguous and does not necessarily mean that he rejects the offer. He may have done acts which remove the ambiguity. For example, he may have accepted benefits under circumstances such that a reasonable person would know he must pay for them; in this case he will be held to have accepted the offer. Silence may also imply acceptance through the course of previous dealings or general practice.

Normally, an acceptance is ineffective unless it is communicated to the offerer. The exception to this rule occurs when the offeree is only required to do an act. In this case, there is no need to notify the offeror if he has any reasonable way of finding out for himself.

If the offer specifically requires that the acceptance be communicated in a certain way, the acceptance will be ineffective unless it complies with this condition. Otherwise, the acceptance may be communicated in any way the offeree selects. Normally, the acceptance will become effective only when it has been received by the offerer. However, if the offer expressly or impliedly authorizes a particular mode of communication of the acceptance, it is held that the acceptance is effective when it is sent, rather than when it is received. There is thus a considerable advantage to the offeree to use the "authorized" mode of communication, even though it may not be a condition of the offer. When the offer doesn't spe-

cifically say anything about the mode of communication, it is held that it impliedly authorizes the offeree to use the same mode of communication as the offerer used. Thus, an offer by mail impliedly authorizes an acceptance by mail. Other implications arise out of business custom.

Communication

If the acceptance is effective when sent, it is immaterial whether or not the offerer ever receives it. It is effective anyhow. By authorizing a method of communication, the offerer (usually unconsciously) accepts this risk. If he wishes to avoid this risk, he can provide in his offer that the acceptance will not be complete until received by him.

If an acceptance is effective only when received, this does not mean that the offerer must read it, but only that it be received at the place where he is reasonably expected to receive mail (such as his business office).

If the offer or acceptance is garbled in transmission (for example, an erroneous telegram), the mistake is binding on the party who selected or authorized the mode of communication. However, if the mistake is obvious, the recipient cannot "snap up something which is too good to be true" because of the error.

In concluding this series on the elements of contract law, it is important to point out several other possibilities which may cause the parties to be bound despite the lack of express offer and acceptance, or which may permit the parties to avoid the binding effect of a contract even where there has been offer, acceptance, and consideration.

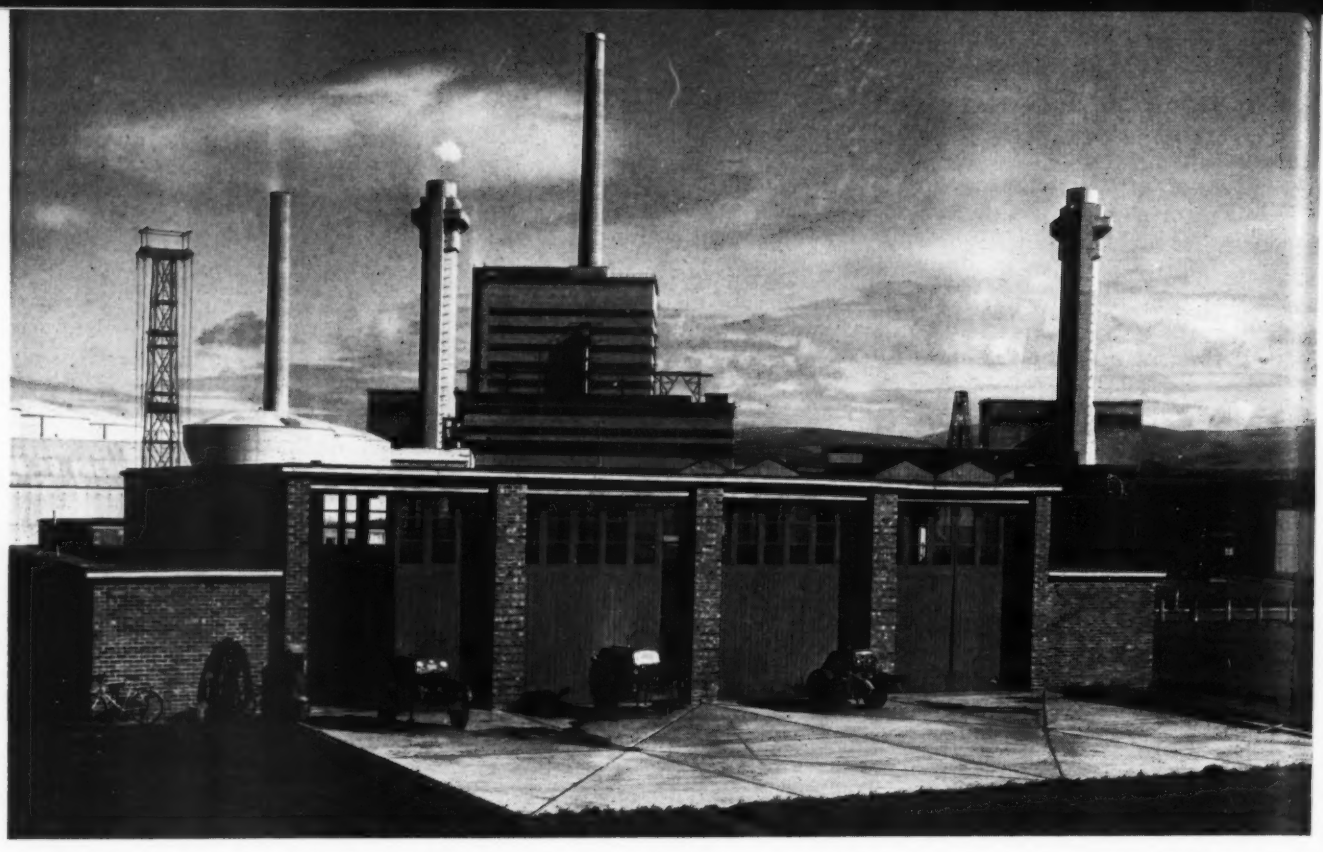
Where there is not an "express contract", arising out of express offer and acceptance, there may be liability based on a "contract implied in fact" or on "quasi-contract". The former means that the agreement has not been expressed in words, but is implied from the acts of the parties. This is, in legal effect, identical with an express contract. A quasi-contract, however, is not a contract, but is only something like it. It arises when A has been

benefited at the expense of B and the retention of the benefit would unjustly enrich A. In this case there is no actual contract, but B is nevertheless allowed to recover the reasonable value of the benefit received by A. In cases where, for one reason or another, a contract fails to materialize, there may be quasi-contractual recovery; this recovery will not in general be identical with the recovery based on the contract which failed to become effective.

Where the elements of a contract exist, i.e. offer, acceptance, and consideration, it may nevertheless be partly or wholly unenforceable because of various defects. For example, one of the parties may lack legal capacity to enter into a contract (e.g. a child, an insane person, etc.); he is given the opportunity to avoid the obligation of the contract but the other party has no choice in the matter. The same is true of a contract induced by fraud, duress, or undue influence. Certain contracts must be in writing, according to the Statute of Frauds. If they fail in this respect, they are unenforceable by action at law by either party although they are not necessarily nullities.

Illegal Contracts

And an illegal contract may not be enforceable by one party or by either party, depending on the circumstances. If both parties are equally guilty, the court will not give any relief to either party. Neither party will be able to obtain enforcement of the contract, and on the other hand, if the contract has been partly performed, neither party will be allowed to recover what he has already given. Some examples of contracts which are illegal are the following: (1) agreements which would tend to injure the public safety, (2) agreements which attempt to influence government officials improperly, (3) agreements which tend to interfere with the course of justice, (4) agreements in derogation of marriage, (5) agreements which are immoral in purpose, (6) gambling agreements, and (7) agreements in unreasonable restraint of trade.



GENERAL VIEW OF THE WINDSCALE WORKS WHERE PLUTONIUM IS PRODUCED BY A SOLVENT EXTRACTION PROCESS.

Britain's Atomic Plants

LEO WALTER, Consulting Engineer

Gloucestershire, England

PLANS FOR TWO atomic power stations, recently announced by the British Atomic Energy Corp., have already been put into action. The fast breeder reactor plant being built at Donnreay, Caithness in the North of Scotland will be self-supporting in atomic fuel supply. Another power plant using two graphite-moderated, gas-cooled, natural uranium reactors is in Cumberland, England, and will deliver electric power into lines operated by the British Election Authority.

Cost estimates indicate that the present design of nuclear power stations might have twice the capital cost of a conventional British Electric Authority station. The water-moderated type of power unit, built for larger output, would be considerably cheaper with the result that the capital costs would be somewhat higher and fuel costs somewhat lower than for conventional stations.

The British Atomic Energy Organization was set up for research and commercial purposes in 1946. It operates the Research Establishment at Harwell, and the Production Division for Isotopes. Both establishments operate nuclear reactors.

The atomic factories operated from the Risley headquarters are located at Springfield for uranium production, at Windscale for plutonium production, and at Capenhurst for uranium 235 production. The experimental atomic power station is being erected at Calder Hill alongside the plutonium factory at Windscale in Cumberland, and is the fifth factory to come into operation. The sixth factory is in Scotland and will produce electric power.

The first nuclear reactor was built at Harwell and was completed in 1948. It is a graphite-moderated, air-cooled, atomic pile and uses graphite rods for control of the nuclear reaction. The experimental pile has been a useful research tool. It also was used to produce radioisotopes for industrial and medical purposes. The atomic factories were made possible by developments at Harwell.

A further step in atomic development was the design and construction of a plant capable of producing uranium from the crude ore imported from the Belgian Congo. The Springfield factory was chosen for this purpose. It had originally been built and operated during the war for the production of poison gas. The factory was particularly well adapted to the production of uranium, since it was already equipped with most of the necessary services and had many buildings suitable for offices, stores, and process work. It was taken over within a month of the formation of the Atomic Energy Production Division in 1946, and the new uranium factory was designed, built, and brought into production in the planned time of 2½ years.

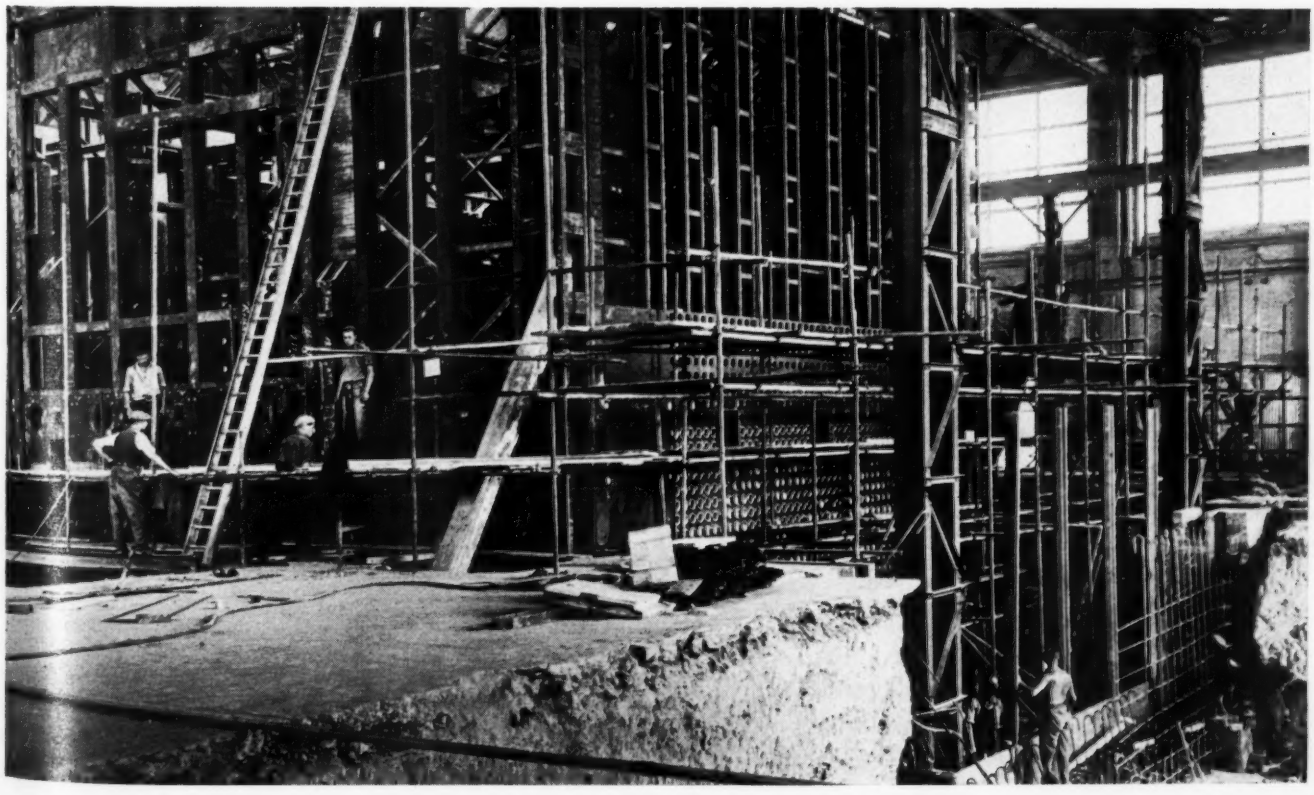
In the process employed at Springfield—based on research conducted during and after the war by the General Chemicals Division of the Imperial Chemical Industries, Ltd.—the uranium ore is crushed to a powder, dissolved in a mixture of acids, and treated with barium carbonate solution to precipitate radium and other metals present as impurities in the ore. Hydrogen peroxide is added to the solution containing uranium to precipitate uranium oxide. The latter, though pure enough by most standards, is sufficiently contaminated with neutron-absorbing substances to preclude its direct conversion to metallic uranium and to its use in atomic piles for commercial production.

The remaining impurities are removed by solvent extraction with ether, the crude oxide having first been converted to uranyl nitrate by dissolving it in nitric acid. The uranium is precipitated as ammonium diuranate and converted to the metal in two stages: first, uranium tetrafluoride is formed by heating the powder in electric furnaces, reducing it, and passing hydrogen fluoride gas over the resulting product; then the tetrafluoride formed is mixed with calcium chips and the mixture fired in a furnace to produce the pure metal.

The Plutonium Factory

At the second of the factories, Windscale, in the English Lake District, plutonium is produced in two large air-cooled piles. The irradiated "slugs" taken from the piles contain only a few ounces of plutonium per ton of slugs, and this is separated and converted into pure metal. The uranium, which as a result of the fission process has been slightly depleted of the 235 isotope, is recovered in a form pure enough to be put back into the pile when its deficiency of uranium 235 has been made up as required.

The separation of the plutonium is carried out in a completely isolated plant by means of a solvent extraction process. The first step is to dissolve the slugs in nitric acid—several tons of acid for every ton of slugs. This solution, which is strongly radio-



THE URANIUM REACTING CORE OF THE ATOMIC PILE MUST BE SURROUNDED BY A HEAVY CONCRETE SHIELD.

INSTRUMENTS AND CONTROLS ON THE DECK ABOVE THE ROW OF PLANT CELLS REGULATE THE CAPENHURST FACTORY.

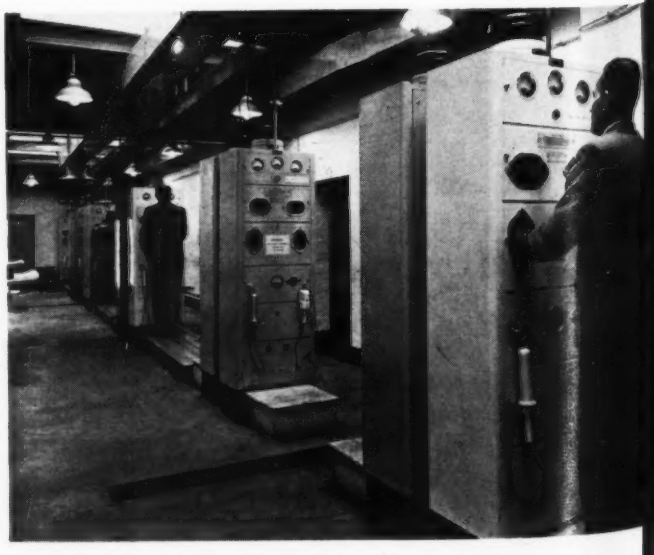
active, is mixed in a column with another solvent which takes up the plutonium but not the uranium or the fission products.

This process was carried out on a plant scale for the first time at Windscale; that it worked so well was remarkable since the information on which it was based had been obtained from experiments made by the Canadian-British Atomic Energy group during the war using microscopic quantities of plutonium and fission products.

The plant has no pumps, valves, or filters; only columns, tanks, and miles of connecting pipe all completely shut away in a concrete box. In view of the high level of radioactivity emanating from the irradiated slugs, every part of the process must be completely screened from the operators and every operation and control carried out from behind thick walls of concrete. Once the plant has been put into operation, it is intensely radioactive, and there is no possibility of getting near it to correct faults or do maintenance work.

Two stacks over 400 feet high discharge the contaminated cooling air at a sufficient height to ensure that by the time it returns to ground level its radioactivity has so decayed that it is harmless.

Few details are disclosed of the methods of remote handling and control employed, but the following description gives some impression of the precautions taken with regard to the arrangements for discharging the uranium cartridges from the pile: "It (the cartridge) is allowed to drop straight down into a deep water channel at the bottom of which it is caught in submerged steel skips mounted on a truck; the water is necessary partly to break the fall of the slug and partly to act as a radiation shield. When enough cartridges have been discharged to fill the skips, the truck is pulled out under water into a deep pond between the two pile buildings; here the skips are removed from the



"HAND AND FOOT" RADIATION MONITORS PROTECT WORKERS AGAINST RADIO-ACTIVE CONTAMINATION.

trucks and the uranium is allowed to decay in radioactivity. After the cartridges have 'cooled' for the requisite period, the skips containing them are drawn, still under water, to a covered part of the pond called the decanning bay.

"Here, from a gallery above the surface of the water, workmen, operating by the light of underwater mercury-vapor lamps, take each cartridge out of its skip with the aid of an 18-ft aluminum handling tool and place it in a machine which removes the can. The naked slug is then dropped into a lead coffin and this, when it is full, is hauled out of the water and taken to the separation plant."

Uranium 235 Factory

At the Capenhurst factory, uranium 235 is separated from the more abundant uranium 238 by a gaseous diffusion process based on the fact that the former has a higher rate of diffusion through a porous membrane. The compound of uranium used for this purpose is uranium hexafluoride, which is a gas at temperatures on the order of 140 F. By using a sufficient number of successive stages in the separation process, the enrichment can be increased to nearly 100 percent.

Absolute cleanliness is essential to avoid formation of compounds with the uranium hexafluoride (commonly called Hex). If this occurs, it will cause loss of valuable material from the gas stream and may clog the membrane, thus reducing effective area and spoiling the performance of the plant.

Development work on the process, begun in England in 1942, was discontinued in 1943, when all accumulated data were placed at the disposal of the joint Allied effort and used in the construction of the diffusion plant at Oak Ridge. Toward the end of 1947, the British Government instructed the Atomic Energy Production Division to re-initiate development with a view to the construction of a major plant in England. The Capenhurst plant is the result of that program.

Health Protection

Extreme care is taken to protect the health of the workers in the atomic factories. A high degree of plant cleanliness is paramount — a requirement which is also of importance in ensuring the purity of the chemical products. At Springfield, wherever there is exposed process material, buildings as well as plant are cleaned every shift.

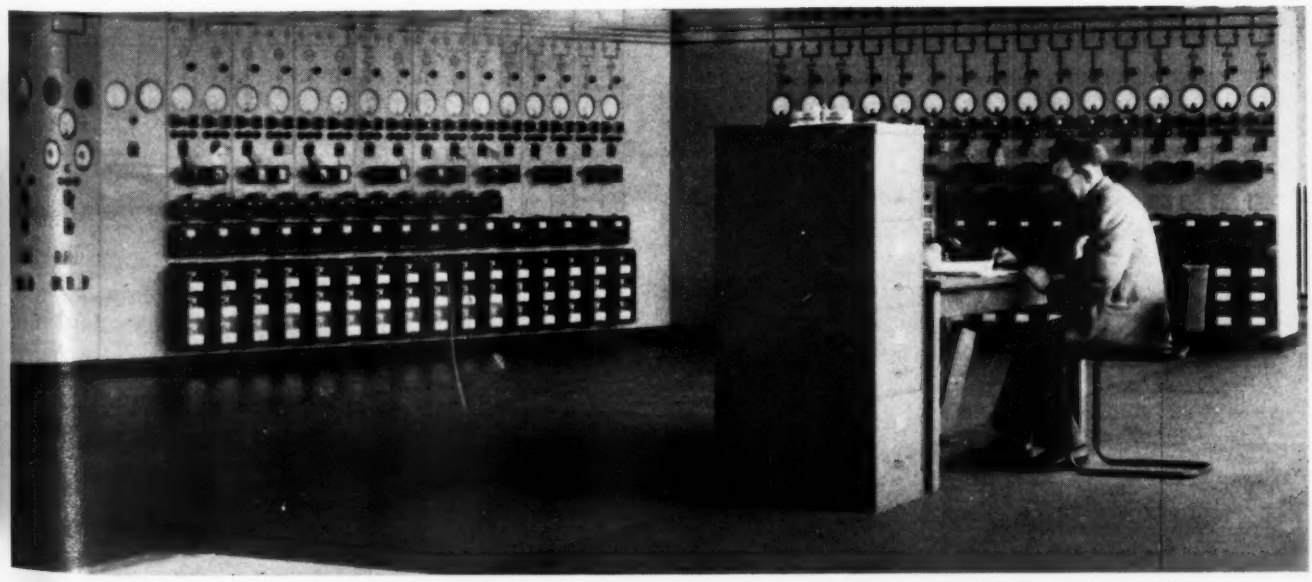
Everyone, without exception, must wear white overalls, white linen caps, white rubber boots, and gauntlet gloves before being permitted to enter the process area. Since the chief hazard is from the ingestion of uranium or radium dust, changing into overalls and caps avoids contaminating the worker's own clothes as well as his hair.

An important task carried out by the health protection staff has been to determine not only what integrated exposures can be allowed for the different types of radiation (alpha, beta, gamma, and neutron) from external sources, but also what maximum amounts of the various kinds of isotopes can be regarded as safe when ingested.

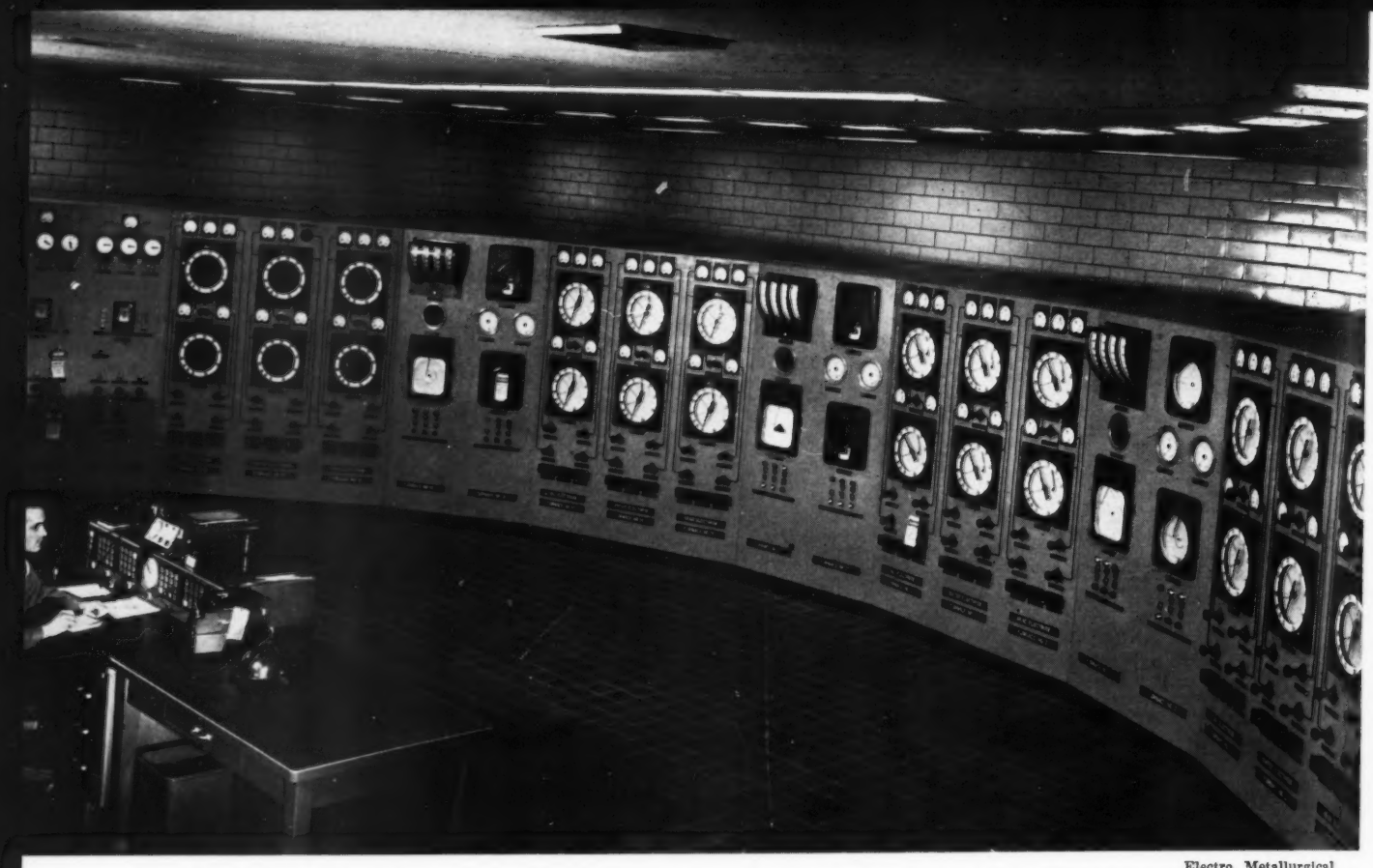
Protection is provided against external sources of radiation by keeping the worker far enough away from the source of radiation or by interposing a suitable screen. For internal sources, all precautions are taken to prevent the workmen from ingesting radioactive materials.

In the atomic power station now under construc-

—Continued on page 88



AN OPERATOR IN THE CONTROL ROOM OF THE MAIN ELECTRICAL SUB-STATION AT THE CAPENHURST FACTORY.



Electro Metallurgical

HUMAN ENGINEERING CONSIDERS THE OPERATOR AND HIS CAPABILITIES AS WELL AS THE ACTUAL BOARD DESIGN.

New Ideas for Panel Boards

CE exclusive

ROBERT J. SCHREIBER
Dunlap and Associates

A FEW YEARS AGO, engineers designing a new hydro-electric plant for a small Eastern utility decided to "go along with the trend" to build plants around the human operator. Accordingly, they designed and built a very attractive room in the shape of a quarter-sphere for the operator who controlled all the switching of the plant—they also built in the sluice and the communication controls. They were proud of their accomplishment; they had built a room where, without moving from his seat, a single operator could do the work three men do in plants of similar size. And, to make the operator comfortable, a color scheme of pastels, diffused colored lights, and multicolored dials and switches were installed. Then one day, one of the engineers proudly reported that the plant was ready to go on the line. The owners and the designers comfortably settled back to await industry-wide approval of their masterpiece. However, the third day of operation, there was an outage—and on the thirteenth—and the 19th! In the first two months of operation there were five preventable outages, all traceable to the control room. How could this be, the designers asked. Every switch and dial was within arms reach, the room was quiet, air conditioned, relaxing. The operators gave them their answer in very few words. "The room's too pretty to work in, and there's too much to do!"

Human engineering is not the functional approach of the esthetically inclined, nor is it a means of reducing the number of jobs or promoting a speed up. Human engineering is the application of known laboratory-derived knowledge of human capabilities to engineering design with the criterion of safer, more reliable, more accurate, and more profitable operation. It draws technique and material from engineering, anthropology, psychology, physiology, and sociology. In engineering termi-

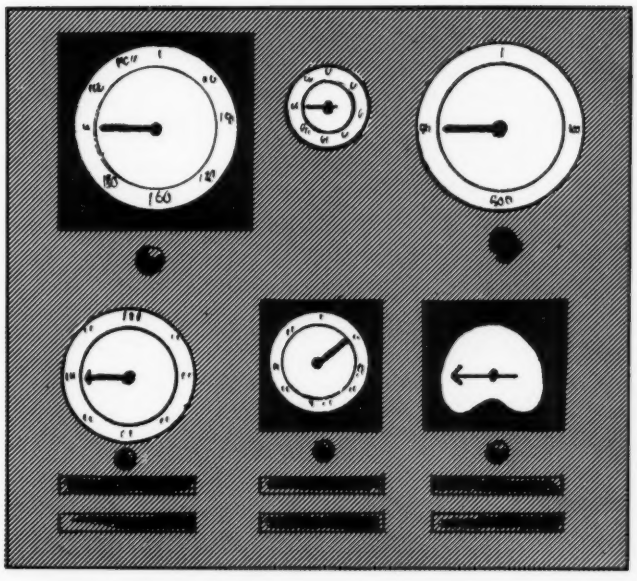
nology, when black box number two must be designed to receive and utilize inputs from black box number one, the complete specifications of the inputs must be known. In human engineering we say that to design a man-machine system, we must know the capability of the man to receive information and his ability to operate on and dispense information. Then and only then can we design the machine components. We have many degrees of freedom in machine design, but man comes to us already designed and operating.

Typical Example

Let us take a typical (but by no means universal) steam operated electric generating station to indicate a few places where better knowledge of human abilities would have improved the design. In this plant the control room operator sits at a desk facing a 25 foot panel consisting of indicators and switches governing the generators and the power distribution. This panel is 9½ feet high; indicators cover the top three feet, and switches occupy the 1½ to 2½ feet below—the bottom portion is unoccupied. The operator continually monitors the panel to detect changes in load and trouble within the station, and he must act accordingly. In addition, he records the readings of most of the indicators hourly for record keeping; his hourly reading must also include totalizing watt-, volt-, and ammeters on the rear of the panel.

In one particular station so designed, the operator cannot detect changes on the dials on the distant ends of the panel. Consequently, if he is conscientious, he walks back and forth in front of the panel. (A designer should know that a marking that subtends an angle of less than two minutes is not visible to the human eye.) Curving the ends of the panel toward the operator could have avoided the problem and would make it possible for the operator to monitor his panel without moving from his desk in order to read the dials.

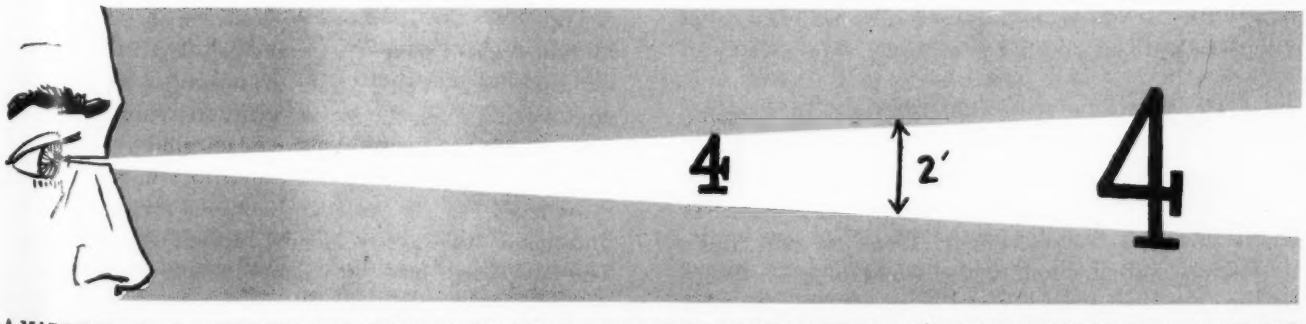
In his hourly rounds, the operator must walk around to the rear of the panel to read the totalizing meters, which, incidentally, are only 15-30 inches off the floor. The total time required to walk around, stoop down, make and record the readings, and return to the front of the panel is of the order of 45 seconds to a minute and a half. Thus every hour, the panel is entirely untended for roughly a minute. A large portion of the preventable outages due to storm, load fluctuation, or any other cause develop in far less time.



IF ALL POINTERS ARE IN NINE O'CLOCK IN NORMAL OPERATION, IT IS EASY TO TELL WHEN ONE IS OFF.

The control room is usually sound-proofed. Yet old time operators will tell you that a trained ear can detect trouble from the sound of the generators —and laboratory experiments show that this is true, that with training, a human can detect very minute changes in the frequency of a tone.

The usual control panel (whether it is in a power plant or in a chemical plant) is polka-dotted with dials. And in most situations, these dials operate at the same position for hours on end. The operator scans a panel where pointers are directed every conceivable way. Yet laboratory experiments have shown that this is the most inefficient design. A study done in one laboratory showed much more rapid and much more accurate scanning when the



A MARKING THAT SUBTENDS LESS THAN 2 MIN. (EXAGGERATED IN ILLUSTRATION) CANNOT BE SEEN BY THE HUMAN EYE.

dials were arranged so that in the normal operating position all pointers are in the nine o'clock position.

The problem of how much a man can do is often a vexing one. We often overestimate, as the designers of the ultra modern power plant did. The most complex jobs can be made to look simple if the controls and indicators are made to look pretty. Buyers and designers of complex equipment are often fooled by stainless steel, blue and red lights, and light green paneling. But unfortunately, most of these designs do not take into account such things as: number of dials that can be read in a given time, perceptible deviation of a pointer, choice of dial, counter, or moving scale. These and a whole realm of questions pertaining to controls perplex those concerned. Usually all the answers are not available from experimental laboratory studies. Then, the human engineer must use different techniques.

Scale Models

One such problem was the arrangement of 15 consoles and control panels in a small control center to be operated by four men. It was not possible to determine which four men in the vast organization would be assigned to the particular plant. In addition, every single piece of equipment to go into the room was either new or radically redesigned; thus none of the potential operators was familiar with all of the equipment. The solution was the use of scale models. First, the designers assembled a list of standard operations and another of emergency ones. Then the equipment was carefully explained and the models were shown to a large sample of the potential operators who were asked:

"If you were stationed at panel No. 1, where would you like each of the remaining panels to be located for each of the following standard and emergency operations?"

The list of operations followed. The question was repeated for each possible panel assignment. Each operator was asked to substantiate his choice with reason or, preferably, from his own experience. The number of choices of each position for each panel was counted, and an overwhelming amount of evidence indicated a pattern very different from that suggested by the equipment designers. An incidental yet important result of the reasoning given was the assignment of an additional operator to the room without whom, experience now shows, emergency operations would be virtually impossible.

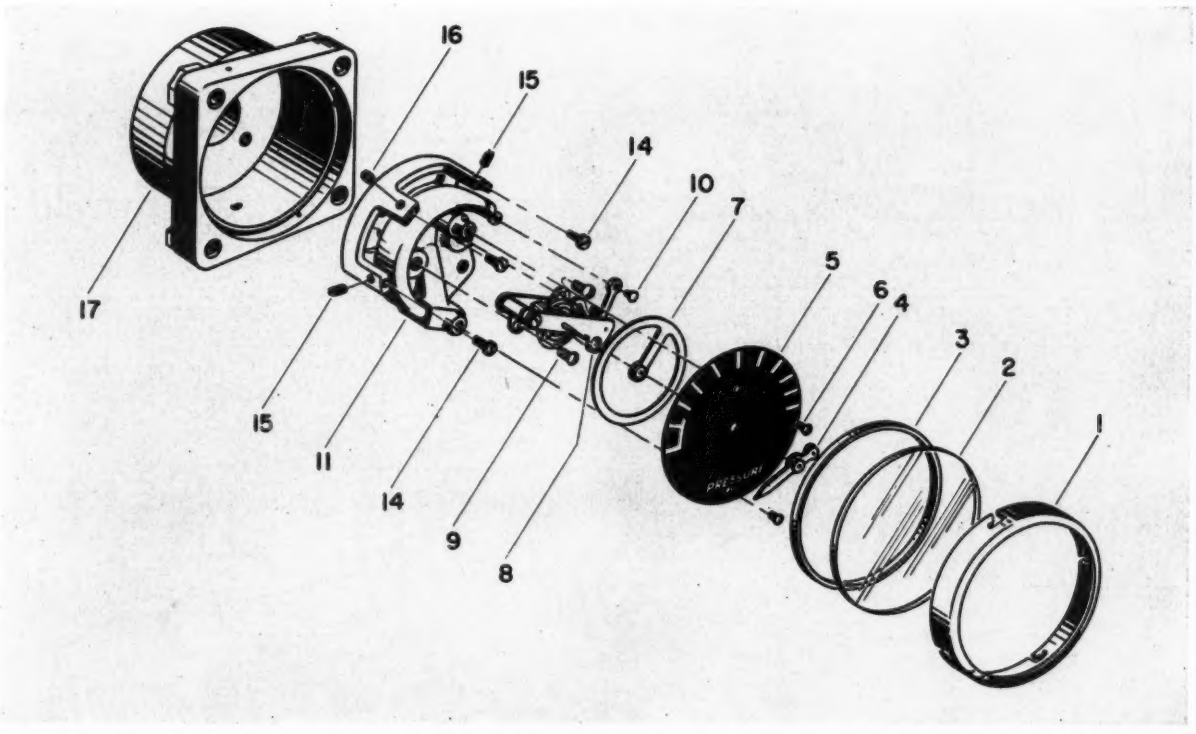
Get Help Early

Usually the human engineer likes to be called in before the layout problem. In fact, he prefers to be called in while the equipment is still a series of pencil lines on tracing paper. Here he can make his largest contribution to the economics of design —if he is called upon for criticism after production is begun, his recommendations become costly. In one instance, the human engineer was called upon to aid a buyer in selecting a rather simple electrical distribution panel. The buyer demanded it be very simple to operate and very easily learned because his operators had many other duties. Incorrect operation might incapacitate a piece of capital equipment worth several millions. The buyer favored one panel and the manufacturers favored another. The latter design featured transilluminated strips connecting the meters, lights, switches, and controls for each generator. The buyer's design merely placed these units in the same portion of the panel. Both the buyer and the manufacturers agreed that the normal operation was simple in both designs, but each contended that in trouble shooting his design excelled. The buyer was sufficiently wise to appreciate the vast experience of the manufacturer, but nevertheless, he had his doubts. The human engineer was asked to come up with sound scientific evidence for a recommendation based on speed and accuracy of locating the source of difficulty. He set up a series of experiments designed to simulate actual incidents. The panels were mocked up with photostats of drawings of each indicator and control mounted on bits of pasteboard. Faults were then simulated with the mock up and presented to a group of operators, individually. Half the problems used the manufacturer's design and half the buyer's design. Time to locate the fault and take action was measured. Analysis of these times indicated no real differences in operation of either panel. Consequently, the buyer was advised to purchase the least expensive of the panels.

The Job to be Done

When operators stand on their toes to read a dial, squint to read a scale or hesitate before reaching for the right control, the symptoms of neglect of the human function are beginning to assert themselves. Human engineering endeavors to integrate the machine to the man. It concerns itself with the design of such minute details as the ratio of stroke width to the height of lettering on a dial and with large scale problem of equipment layout. Human engineers, experts in the capabilities of man, working with design engineers, experts in the requirements of machines, can produce integrated, more efficient man-machine systems for modern industry.

There is still much to be learned in this field of human engineering. A great deal of work has been done in the past few years in making use of human engineering in designing aircraft instrument panels. The experienced gained is being carried over into the industrial field, and engineers who want to get the most from men as well as machines must apply the findings of this relatively new branch of engineering. The result will be better panel design so that operators can do better jobs with less strain. It is a field worth the consultant's study.



EXPLODED VIEWS ARE EFFECTIVE WHEN EXPLAINING MECHANICAL ASSEMBLIES TO NONTECHNICAL MEN.

Illustrating Engineering Reports

HARRY E. KRAUSS, JR., Vice President
Foster-Vrooman-Krauss Company

CE exclusive

IF ENGINEERS had to deal only with other engineers, illustrating the technical report would be a fairly simple matter. Conventional mechanical drawings or even simplified drafting methods would suffice. But the engineering report is most often written to explain a technical matter to non-technical minds. To be effective the illustrations, as well as the language and the vocabulary, should be readily understood by the layman.

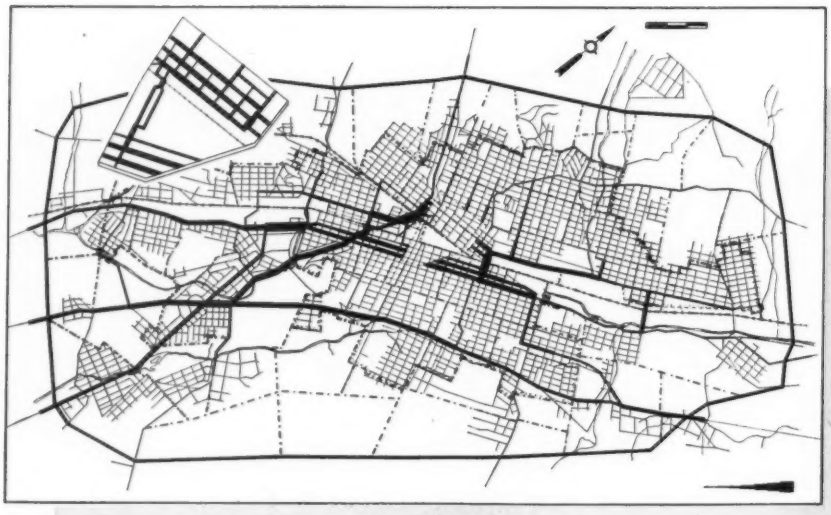
One of the most effective devices for clearly illustrating the construction of a mechanical device is the exploded drawing. The use of this technique became widespread during the war to explain assembly problems to non-technical or semi-technical personnel on the assembly line or in the battlefield. Exploded drawings can be helpful in engineering reports, but their usefulness is largely limited to explaining mechanical assembly or, more rarely, building construction or plant layout.

There are many other techniques for illustrating which should be used more frequently in the engineering report. It cannot be denied that the use of perspective clears up many pictures for the non-technical eye. Beyond this are the purely emotional questions of sales appeal. Few reports are written that do not have the sale of some idea as one of the foremost reasons for their existence. Even a progress report is an attempt to sell the reader on the idea that the job is being properly handled. Certainly, the more attractive the report's illustrations, the more likely that it will accomplish its purpose.

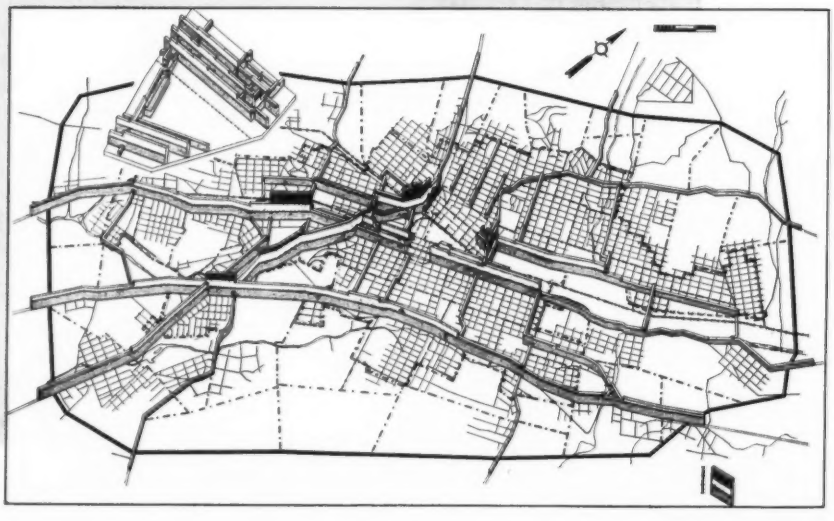
The limits of elaborateness for illustrations are the cost of reproduction, and the confines of good taste and good sense. Few engineers would feel the need for using report illustrations lithographed in nine colors with ornate gold leaf framing, even if the cost of reproduction were within reason.

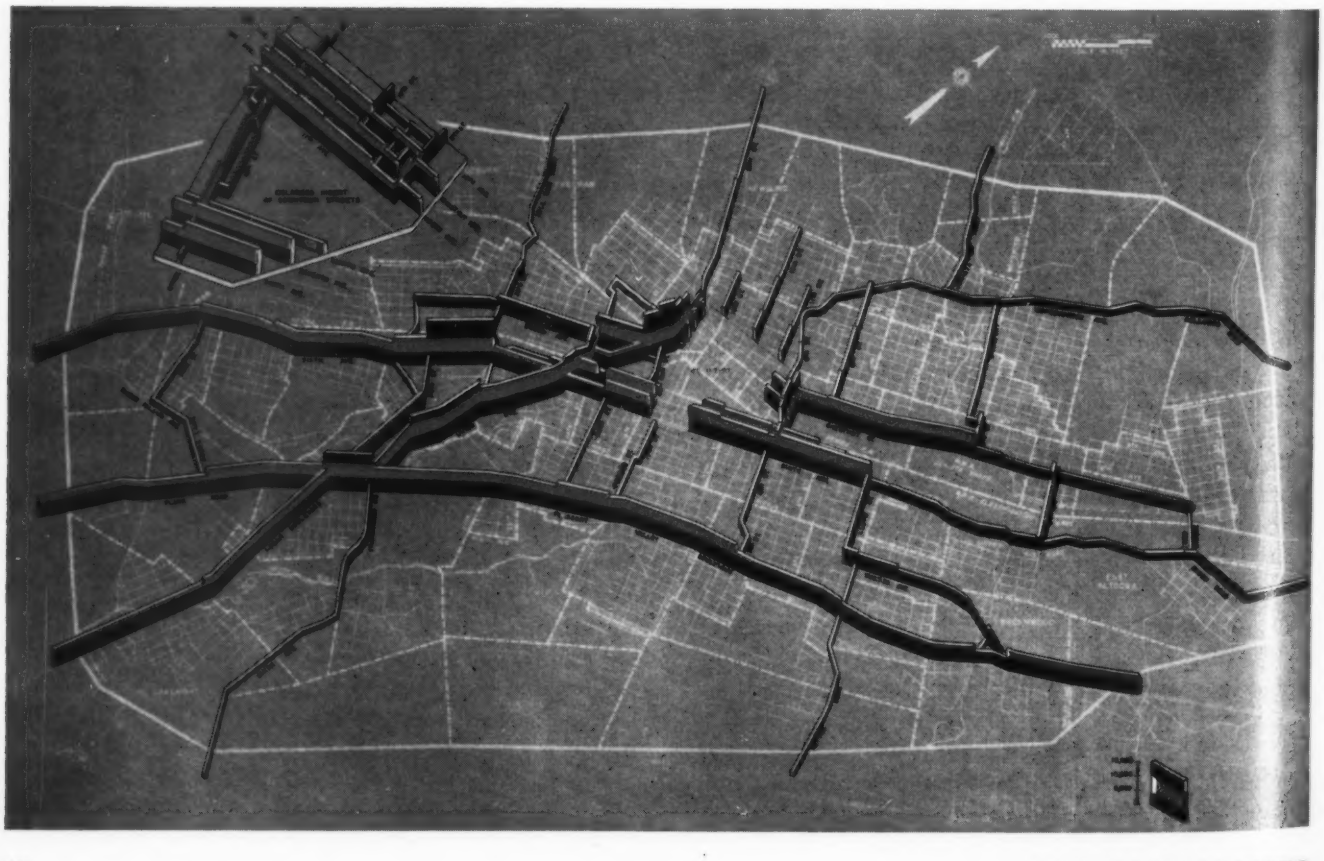
The work of a technical illustrator—as opposed to that of a draftsman—can be advantageous, and authors of engineering reports would do well to follow the example of the architect and make more use of renderings and less use of straight engineering drawings.

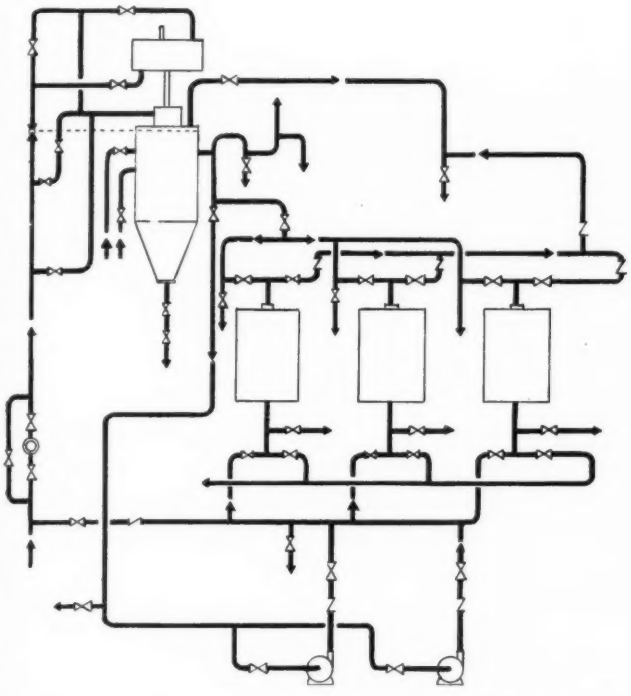
The accompanying drawings show two ex-

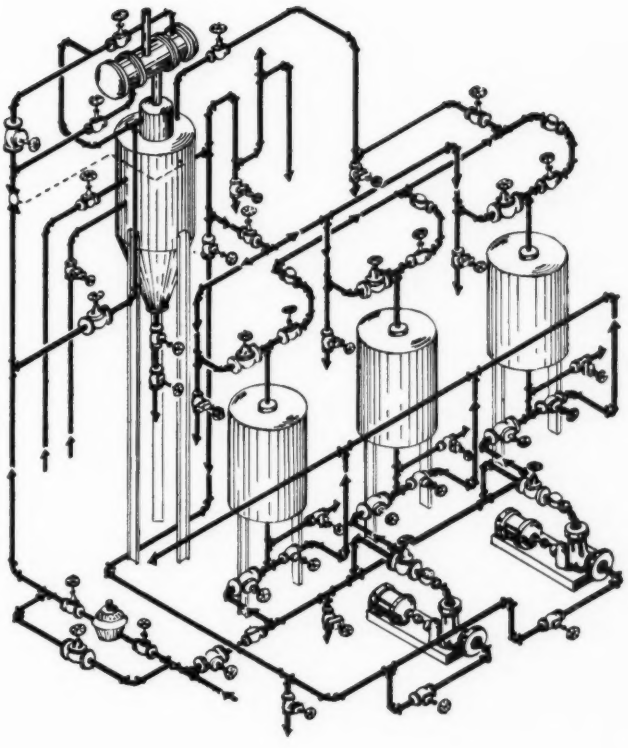


WEIGHTED LINE DRAWING, ABOVE, IS MADE CLEARER BY USING THREE - DIMENSIONAL EFFECT, RIGHT, AND FURTHER IMPROVED BY ADDING COLOR, SEE BELOW.

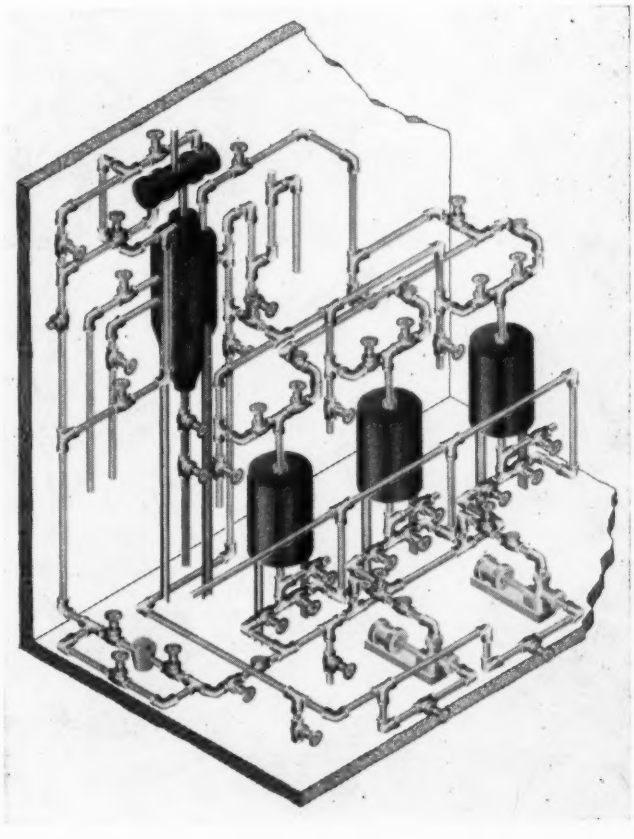








EFFECTIVENESS OF THE SCHEMATIC DRAWING, ABOVE, IS INCREASED BY ADDING THIRD DIMENSION AS SHOWN AT RIGHT. THE AIR BRUSH TECHNIQUE AND COLOR, SHOWN AT LOWER RIGHT, ADDS SALES APPEAL.



amples of illustrations from engineering reports, and three styles of drawings for each illustration. In each series, the first example is simple engineering drafting, relatively inexpensive and certainly satisfactory for intra-engineering work. The second example shows a perspective drawing which could be made by most good draftsmen and certainly could be made by any commercial artist capable of reading the original blueprint. The third, and most elaborate example, is more than most draftsmen could handle. It makes use of an airbrush as the medium, and it involves the use of an overlay of color which would require a color separation, either by the artist or the engraver, if the report is to be printed.

No one can deny the added sales appeal of the third example with its use of art work and color. On the other hand, its cost may be more than the company is willing to pay for the reproduction of relatively simple illustrations. The additional cost lies not so much in that a technical illustrator costs more than a draftsman—he doesn't—but that the job has to be done twice, once by the draftsman and then by the illustrator using the drafting work as a guide. Also, if the report is to be printed, it costs just about twice as much to print with just one extra color as it does to print in black and white. For every additional color, the paper must go through the press again, at additional cost even if the added color is simply a rule or a spot.

By understanding the facts of printing, the author can make the very best use of the money available for preparing and printing his report and the smart layout man can produce a much better looking report and still have money left from his appropriation to pay for better art work and attractive, functional color which will impress his client and sell the job. ▲▲

The Engineer As An Expert Witness

ANY ENGINEER may find it necessary, at one time or another, to appear as a technical or expert witness in litigation. This may come about in the normal process of his consulting services—where he may voluntarily accept a contract with a lawyer who is seeking his specialized technical qualifications. More than likely, it will come as an outgrowth of an investigation of failure or of defective parts in structures or machinery that have caused loss of life, personal injuries, extensive property damage.

The first step is to gather all the relevant facts and data pertaining to the case. Direct evidence may come from personal observations, from conversations with those most familiar with certain aspects of the case, eye-witness reports, and even from local gossip. These findings can often be further developed through engineering studies.

However, in many types of failures, such as explosions, major short circuits of electrical equipment, or extensive fires, the parts near the origin of the fault are frequently destroyed or badly mutilated. If they are not available for examination, the engineer must base much of his effective and constructive reasoning on circumstantial evidence.

Circumstantial evidence can be invaluable and the success in developing it depends essentially on specialized qualifications and an intimate knowledge of the salient parts, the construction, and the

properties of the materials involved in the failure.

A comprehensive report will present an orderly review of the factual evidence, data obtained by engineering and scientific processes, and explanations of whatever interrelationships of the evidence are necessary to arrive at the theory for the causation of failure. The use of photographs, line-drawing sketches, tabular data, or graphical curves are helpful and, depending on the nature of the study, perhaps even essential to a complete presentation.

Clear and Understandable Report

In the final analysis, a report that is to be of value to such non-technical people as attorneys, claim adjusters, or officers of a company, must be characterized by a clear and understandable treatment of even very difficult and highly technical subjects—and placed well within the intellectual grasp of the court and jury.

Often, a comprehensive report can prove helpful in bringing together the opposing factions, and a fair and equitable settlement may result. When a settlement cannot be effected, litigation becomes the alternative. At this stage of the proceedings, the plaintiff may be barred from gathering additional information at the defendant's property, except through recourse to court order for examinations before trial and other special allowances provided by law or granted by the courts.

Commencement of Litigation

Unfortunately, and all too often, it is only after a court summons has been served that technical witnesses are called into the case. Obviously, the expert witness is seriously handicapped by this delay—lack of adequate, authentic, and firsthand information and also an irretrievable loss in not being able to obtain (at that late date) much of the valuable evidence. Under these conditions, the expert witness is placed in a difficult and embarrassing position. At best, after he has become oriented so that he can obtain all available facts, he can only sketchily piece these together into what he believes is a credible theory.

On the other hand, if the expert witness has enjoyed the privilege of participating in the development of the case from the day of the occurrence, he feels secure in his preparations—knowing firsthand the essential facts, findings, and theory basic to the case. If the case has been carefully prepared, he has sat at the counsel table with his colleague experts, conferred with them, contributed to discussion and argument, advanced ideas of his own, arrived at final agreements, and shared in tutoring the counsellors in the pertinent engineering terminology.

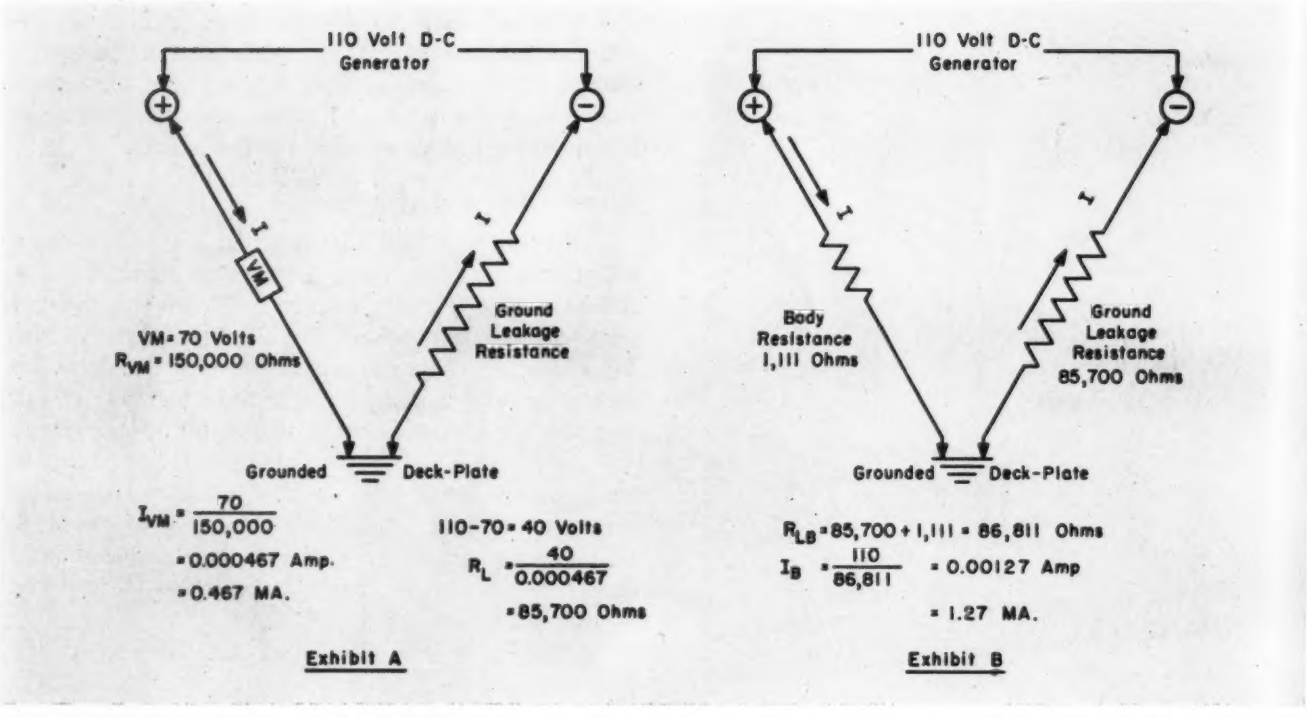
Preparing the Witness for Examination

Shortly before the trial reaches court—following preparation of a final report covering the sifting of all evidence, the formulation of a complete theory, and with accepted conclusions available—the expert witness, with the assistance of the lawyers, should undergo instruction regarding the

ROBIN BEACH

Consulting Engineer

Robin Beach organized his consulting firm in 1944 specializing in industrial electrostatics. His investigations of costly fire and explosion losses frequently call him to court as an expert witness. Dr. Beach started his career teaching electrical engineering. Since that time, his numerous activities range from writing textbooks to serving on both President Truman's and President Eisenhower's Conference on Occupational Safety.



A SHIP'S RADIO OPERATOR WAS KILLED WHILE TRYING TO LOCATE A GROUND AT THE MAIN 110-VOLT SWITCHBOARD. THESE DIAGRAMS HELPED PROVE THAT HE COULD NOT HAVE BEEN KILLED BY CURRENT FROM THE PARTIAL FAULT (1.27 MILLIAMPS) BUT DIED WHEN HIS HANDS ACCIDENTALLY CONTACTED THE 110-VOLT SWITCHBLADES.

best methods of preparing and presenting his testimony to the court and jury.

The judge and the members of the jury must be considered laymen always with regard to technical phases of the case; hence, the presentation of the technical testimony must be stated in language which can be readily understood. In many instances, simple illustrations serve as invaluable aids in driving home basic concepts. Enlarged photographs, maps, models, and other visual aids, are all helpful in presenting engineering principles, practices, construction and operational details.

Diagrams Help

Well developed crayon diagrams on large sheets of paper mounted on wall-board backing provide the equivalent of blackboard work. The important elements of a drawing may be gradually revealed as the case progresses. While being drawn, the parts may be appropriately labelled and necessary explanations given as the illustration is completed. A drawing of this type may be used as an important reference throughout the entire case. Such drawings have the advantage of being readily convenient for marking, submitting, and filing as permanent court evidence. The work should be executed in as faultless a manner as possible and labelled in sufficient detail to be self-explanatory at completion of the presentation.

An expert witness should at all times remember that his function before the judge and jury is that of interpreter of scientific and engineering factual information. His testimony can only be helpful in court when his answers to questions are made as clear and as brief as possible. The expert witness will also add materially to a clear direct explanation by so describing parts and operations of equipment and structures that, in reading back the testimony from the notes of the court stenographer, the transcript will convey, with the aid of illustrations if given, the make-up of the equipment and structures, the characteristic operation, and the manner in which failures or defective parts occurred.

Generally, ordinary witnesses, that is non-expert witnesses, must testify only to facts and not to their opinions and conclusions drawn from facts. The administration of justice, however, requires that a jury should receive the assistance of those especially qualified by experience and study to express an opinion on questions of fact relating to science.

Types of Evidence

Types of evidence and their values to a court case should be understood and their usage appreciated by the expert witnesses. For example, direct evidence is that which tends to show a fact or matter in issue without the intervention of proof of any other fact. But, as frequently happens, no person has been present at the time of the occurrence. Consequently, no one can be called to testify regarding it. It is, therefore, necessary to use other modes of evidence, provided such proofs can be relied on in

leading to safe and satisfactory conclusions.

In such instances, circumstantial evidence may be offered as proof. This simply means that, under certain conditions, from the proof of one fact or set of circumstances, certain other facts may reasonably be inferred or presumed.

Drawing Conclusions

Conclusions to be drawn from the facts as well as the knowledge of the facts themselves depend on professional or scientific understanding not within the range of ordinary training. The expert witness, therefore, may testify not only to the facts, but also the conclusions to which they lead. Furthermore, such testimony need not be confined to facts within his personal knowledge, but may be extended to his opinion based on an assumed statement of facts. This is done by way of a hypothetical question. The assumed facts must be stated hypothetically, and he must express his opinion based on the assumption of the facts so stated.

Effective Presentation

When the expert witnesses have their meetings with the lawyers to determine the most effective methods of presentation, each of the several expert witnesses should be given the opportunity to present that part of the testimony which he will be called upon to do in court. Also in these meetings, he should aid counsel in framing and answering the hypothetical question. The witness should be encouraged to go through all the steps of development for which he is responsible, as later will be expected of him in court. These practice sessions are important to a successful presentation of the case.

If the expert witness can do this with complete satisfaction before his associate expert witnesses and the lawyers, he should be able to do as well in court and answer whatever questions are propounded to him on direct examination by the lawyer for his side of the case. Preparation of this character is aimed not only to give assurance of clear and complete testimony but also to give him confidence so that he will not appear nervous on the stand. The judge and jury will watch every move, demeanor, and expression and will be impressed favorably or othrewise by the witness. Sometimes the jury may be even more impressed by a wise appearance than by wisdom itself.

DEFENDANT CLAIMED THAT THE PAINTER, SITTING ON THE CROSSARM, COULD NOT CONTACT OVERHEAD WIRE. MODEL PROVED HIS HEAD DID TOUCH LINE.

A GAS LEAK, DUE TO RAPID ELECTROLYTIC CORROSION BY GROUND CURRENT RETURNING VIA BURIED PIPES, IGNITED AND BLEW UP THE SUBSTATION.

Speaking Volume

In giving evidence within a courtroom, expert witnesses are almost unanimously criticized by the lawyers and the judge for lack of sufficient speaking volume to be heard comfortably and without effort by the court and jury and even by the court stenographer. Courtrooms are usually large in volume, and the normal speaking voice does not carry far. For this reason, expert witnesses should practice and remember to speak at an energy level well above their normal conversation, enunciate clearly, and watch the audience (especially the jury) to note whether he is being heard and understood.

Warning Note

A word of warning should be given to the neophyte expert witness never to discuss any phase of the court case with anyone, including friends and strangers, outside of his circle of associates on the case. In fact, he should not even admit to a friend or stranger that he is concerned in or employed as a technical witness on a court case. An inadvertent comment from a technical witness relating to any phase of the dispute may find its way back, as has so often occurred, to those on the other side and sometimes to the serious detriment of his asso-

—Continued on page 90

EVEN ON FOREIGN JOBS (EL SALVADOR DAM) HARZA THINKS A BETTER JOB IS DONE WITH DIVIDED RESPONSIBILITY.

Why We Oppose Turn-Key Projects

RICHARD D. HARZA, Vice-President
Harza Engineering Co.
Consulting Engineers

A major problem facing the engineering firm today is the "turn-key" project and all it involves. Can one firm do a good job of both engineering and construction? Honest men are on each side of the argument. CONSULTING ENGINEER has carried articles showing the advantages of "turn-key" projects. Here is another opinion — a voice raised in opposition.

Richard D. Harza is successfully following his father's footsteps. After earning his B. S. in M. E. and M. S. in C. E. at Northwestern, he helped design and engineer a number of large hydro plants. While many of the ideas here expressed originated with the elder Harza (CE Dec. 1953), his son is affirming these convictions.

WRITINGS HAVE APPEARED in American technical literature urging the use of "Turn-Key" contract for development work. By this term is meant the awarding of a contract for any development project to one company or syndicate which assumes full responsibility for engineering investigation, design, and construction of the project; and finally the handing over of the key to the finished project to the owner (hence the term "turn-key" project). In other words, the owner has nothing to do from the time of affixing his signature to the original contract until he accepts the key to the works, unless it be progress payments in the meantime. A better and more descriptive term is "one-package" project.

This is an alluring way to award development work:

a. By inexperienced government officials in small countries where governments may change frequently and where no continuity exists through employed experienced engineering advisers at the call of such officials.
b. By government or private agencies in times of emergency—as in war time—when action is imperative and when equipment must be purchased quickly, wherever and from whomever it can be had, regardless of whether it is best adapted to the purpose.
c. By the uninformed executives.
d. By the lazy executive.
e. By the executive naive enough to believe that by hiding the engineering cost in the syndicate figures, he escapes paying them.

But there are several reasons why it is quite impossible to reach the maximum degree of economy or to realize the benefits of the highest quality of engineering service under this form of contract. Any completed engineering work is, or should be, the realization in concrete form of the unrestricted, unbiased, and uninfluenced engineering thought and study devoted to it; not primarily for profit, but for pride in reaching as nearly as possible the perfection of accomplishment, technically and economically.

A Typical Example

Using a hydroelectric project as an example, the type of project with which our firm is most familiar, let us follow through such a package project.

We will assume that a preliminary study has been made of the project by an engineer of local competency and that a general scheme has been evolved for the project. After this stage is reached, proposals are requested for the complete engineering, purchasing, expediting, and construction of the project, in a "one-package" or "turn-key" project.

The people who propose on such work most likely will be syndicates formed for the purpose, each consisting of a construction contractor, an engineering firm, a hydraulic turbine manufacturer, manufacturers of generators and switchgear, and structural steel—or firms combining some of these fields of operation.

What kind of a proposal is possible under these circumstances of preliminary design, very approximate quantities, and machinery companies proposing on selection of their own equipment?

Obviously, the many modifications and improvements which arise as the result of the mature thought and intensive study which a project receives under detail design cannot be evaluated at that time; the many contingencies that arise during construction are unforeseen and unforeseeable, or they would not be contingencies. Therefore, proposals must be on a cost-plus-fee or similar basis, or they must carry a very large contingency burden, sufficient to allow for any and every eventuality.

It is axiomatic that the more completely a project has been studied, the more complete and detailed the design and specifications, the more definite the field information, the closer the project can be estimated. If the project is only broadly determined, the prices can only be broadly quoted.

Owner's Prerogatives

From the owner's standpoint, he sacrifices his prerogative to select the engineers, constructors, and the machinery for the plants, for he must accept the personnel and equipment of the members of the syndicate he selects. He may not have equal confidence in all of the construction contractors; in all of the engineers; in the different machinery offered; but he must accept the whole syndicate, or some other one. He may regret some of the machinery that he must swallow in order to get the general construction contractor or engineer of his preference, or vice versa.

Minority Interests

The engineering firm, the turbine builders, the steel firm, and other individual suppliers in the syndicate are minority interests. Their hopes of getting in on the job are dependent not on the merits of their own individual abilities or equipment, but upon the chance association with a group which proves to be successful bidder in the aggregate proposal.

Any finished project is just as good as the engineering. But the engineer in a syndicate represents only about 6 to 8 percent of the syndicate; it is hopeless to think that the tail can wag the dog. As a minority interest, he is sure to be dictated to and overruled by majority interests. In fact, to our certain knowledge of the inside affairs of one widely operating contractor-engineer combination, the engineers feel very unhappy that their thinking always must be secondary to the construction expediency.

Equipment Suppliers

It is quite absurd and an evidence of engineering naiveté to believe that even the biggest and best equipment builder will supply the equipment in all respects best adapted to the project. He will furnish his own, and no one manufacturer builds all of the best equipment at any one time.

For some years after its development, only one firm was equipped to build the so-called Kaplan or adjustable blade turbine. Later it was licensed to nearly all manufacturers. A certain electrical company once developed a very superior thrust bearing for vertical units long before an equally good bearing was developed by anyone else. Every manufacturer is engaged in the most intensive struggle to keep ahead of his competitors in desirable im-

provements, efficiencies, reliability, cost.

When one accepts one manufacturer as a member of a syndicate to supply a certain portion of the equipment, such as the hydraulic or electrical equipment, he accepts his equipment for better or for worse; better in some respects, no doubt, worse in other features. In any event, the purchaser has waived his right of choice.

High class purchasing can only be achieved by considering each line or item of equipment on its own merits—in view of the then existing state of development by different manufacturers—without lumping it with other unrelated items.

In a foreign country, we were once asked by an American turbine manufacturer to use our influence against turn-key award of a certain project. The manufacturer pointed out that, to be considered at all, he must find a construction contractor and an electrical contractor with whom to combine and take his chance on the ability and willingness of both to make a proposal which might prove successful. The sale of his equipment thus had no relation to its merits, but was dependent upon others of majority interest over whom he exercised no control. He wanted to sell his equipment on its own merits. Could one blame him? Or could one justify any other basis?

Independent Engineering

Quality engineering can be achieved only by selecting an engineering firm independently of contractor and equipment suppliers and on the basis of the firm's experience and success in engineering projects of like nature; a firm made up of men who have spent their lives as specialists in the field for which their services are now required, who keep abreast of all developments and improvements in that field, and who can render independent and disinterested judgment — not judgment influenced by the financial interests of a syndicate of which they are a small minority stockholder.

To buy a one-package project is doubtless a big temptation to an owner who hopes thus to dump his responsibility into another's lap. He could accomplish this as successfully, and with much better results in the final product, by employing a disinterested engineering firm of broad experience and ability, specializing in his type of project. The engineer is properly the owner's adviser and representative, his agent to any degree that he cares to delegate his powers, and the party to whom he can look for advice.

But the package project promoter, advocating a turn-key job, replies: "We will do your engineering for nothing. It is all included in the package which we sell you at no extra cost." This is a doubtful statement, to say the least. If the project is to be built, engineering studies and investigations, drawings, surveys, and layout work must all be made. And these must be paid for, whether directly by the owner or through the syndicate. In the latter case, the cost is merely buried. If paid directly by the owner, the engineers become responsible to him, his advisers. If engineering costs are paid indirectly, by being buried in the syndicate costs, they are still paid by the owner, but the owner loses the direct service and advice of his engineers. They are now advisers to the syndicate, not to him. They cannot advise the owner directly in his own interest, but only through the syndicate in the manner that best suits the interest of the syndicate majority.

Syndicate Interests

Moreover, if an engineer once joins such a syndicate, he is, for the duration, committed to the interests of the other members of the syndicate; to the hydraulic equipment builder, the electrical company, the construction contractor. He thereby loses his status as an independent, disinterested technical adviser and becomes known as prejudiced in favor of these associates. It is idle to suppose that he can afterward recover and re-establish himself as an independent thinker and adviser.

Professional engineering must be independent engineering. A professional engineer must have something of the spirit of the scientist to whom the success of his work is paramount and profit secondary in importance. In fact, if an engineer is paid on a percentage basis, his most diligent efforts to serve his client best, by economical designs and cost savings, wherever possible, are contrary to his own best financial interest. In this respect, he is penalized for his efforts; the more he saves for the owner by good engineering, the lower his fee.

Professional Motivation

This is unfortunate, but difficult—if not impossible—to remedy. If the lawyer wins a suit for a million, he has a direct measure of the value of his services and can take a proportion of the winnings as his fee. If an engineer, by exhaustive study of a problem, finds an ingenious design which reduces the cost of a project by one million, the owner probably never knows it or believes it. There is no basis for comparison. The engineer is supposed to design as economically as possible. If he works on a percentage basis, his fee is less and his cost more; if on a lump sum basis, his cost is more and the residual profit less. But the engineer must be willing to accept his lot. It is this devotion to the interest of the project, regardless of profit, that makes engineering a profession.

The engineer, built into a syndicate for a package project, might be in a like professional relationship with the syndicate, but he must be classed as a commercial engineer to the owner. He could not serve the owner's best interests in that capacity.

Thread Inserts Solve Many Design Problems

EDUARD BARUCH
Vice-President
Heli-Coil Corporation

STAINLESS STEEL INSERTS, USED ON INDUCTION FURNACES, PREVENT BOLT SEIZURE CAUSED BY HEAT.

BECAUSE they reduce the cost and weight of original equipment, improve design, and decrease the cost and time required on maintenance and repair, design engineers are using increasingly greater numbers of wire thread inserts. These simple but effective devices can be used with any material in which a thread can be tapped.

Wire thread inserts are precision-formed coils of AMS 7245-B stainless steel wire (or AMS 7247-B phosphor bronze for special applications), with a diamond shaped cross-section which accommodates internal and external threads simultaneously. Because of the work hardening produced during manufacture, stainless steel inserts are tougher than standard capscrew and stud materials.

When assembled in a specially tapped hole, the insert presents a permanent internal thread that conforms to the National Bureau of Standards Handbook No. H28, "Screw Thread Standards for Federal Services," published in 1944, and its 1950 supplement.

Higher Loading Strengths

Their flexibility causes the inserts to automatically adapt themselves to the female receiving threads of the part and the male threads of the fastener, and also to compensate for angle and lead error between mating threads, thus distributing the load equally over all of the threads. Wire thread inserts give a minimum of 25 percent greater loading strengths than unprotected tapped threads in the same material.

Recent tests conducted on 24ST4 aluminum resulted in bolt breakage at 275 in-lb in the insert-protected hole, while a bolt inserted in an unprotected hole in the same material broke at only 175 in-lb after the tapped threads had begun to strip.

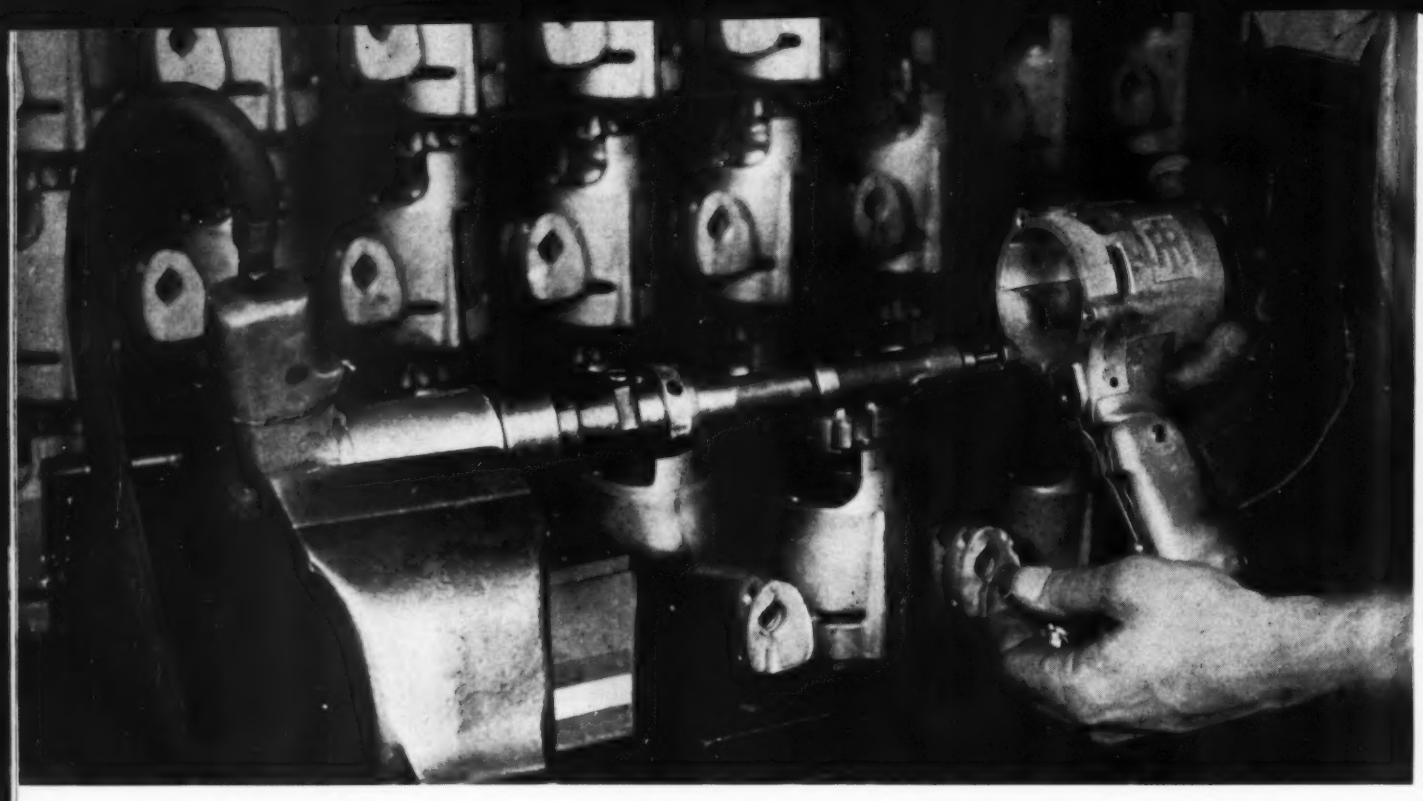
Space and Weight Reduction

Important weight reductions can be achieved by using inserts. Since they are formed of wire, they are considerably lighter in weight than a solid bushing for the same thread. They also require less space than solid bushings or bolt and nut assemblies, and bosses need not be any larger in diameter than that required for standard thread assemblies.

Inserts also permit the use of lighter materials which previously could not be considered because of their low tapped-thread strength values. By using inserts, designers have been able to change from iron to aluminum, from steel to plastics, and even from aluminum to magnesium to save weight.

In converting the side covers of their calculating machine from aluminum to magnesium castings, engineers of a west coast manufacturer improved the thread characteristics of the tapped holes by installing three inserts in the cast side covers. These inserts serve three purposes. First, they provide internal threads having a tensile strength up to 50 percent greater than is possible in the magnesium alone. Second, the tight fitting and specially treated stainless steel inserts prevent electrolytic action which would occur if standard steel threaded fasteners came in direct contact with magnesium. Third, the inserts eliminate thread damage and wear which would otherwise occur when the side plates are removed for cleaning or servicing.

In another example, wire inserts reduced the weight of a fire pump from 600 to 350 pounds simply by enabling the designers to specify aluminum



INSERTS, USED IN IMPACT TOOLS TO STOP THREAD WEAR CAUSED BY VIBRATION, ARE INSERTED BY POWER TOOL.

to replace the cast iron formerly used for the casing. Until inserts were used, this change was not possible because of the relatively low thread strength inherent in aluminum. An experimental aluminum pump body with standard tapped holes had previously proved unsuccessful. When the 70 tapped holes in the casing were reinforced with inserts, however, the assembled housing safely withstood the required 800 psi hydrostatic test.

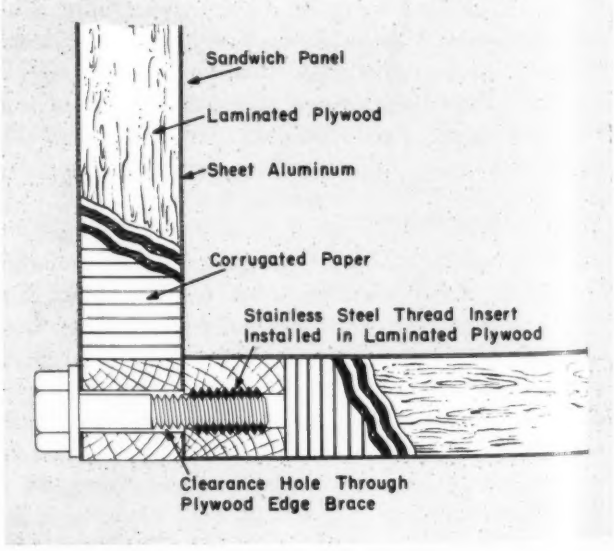
By installing wire screw thread inserts as original components in its Rawin Meteorological Scanner, the Allen D. Cardwell Co. has been able to achieve significant weight reductions and has eliminated excessive labor and material costs formerly required to repair damaged threads. The Rawin unit is a portable, radio direction finder designed to automatically track a balloon-borne radiosonde transmitter.

Since weight must be kept at a minimum to facilitate moving the unit from place to place, aluminum castings are used throughout the unit. Before the inserts were used, it was necessary to allow for possible future thread repairs by designing excessively large boss thicknesses.

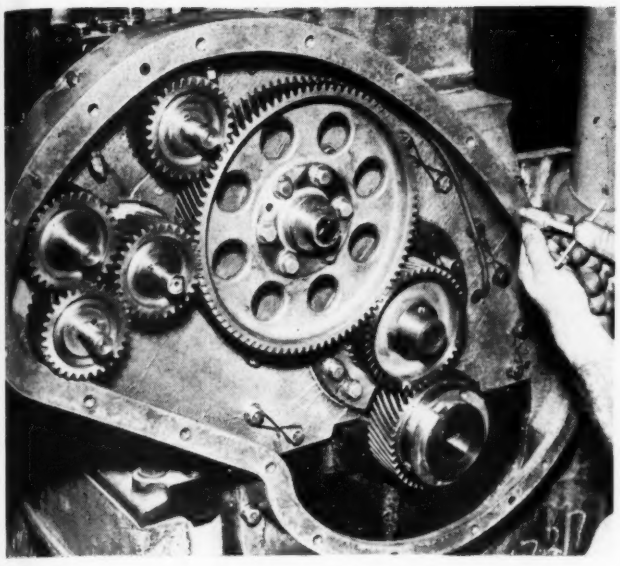
Inspection, adjustment, and maintenance on this piece of equipment necessitates periodic removal of parts. Pedestals and hand knobs must be adjusted daily, and receiver and instrument housings must be inspected weekly, thus subjecting the threads to considerable wear. Extreme temperatures in arctic and sub-arctic climates and the sea air in coastal regions promote rapid deterioration of unprotected threaded holes, and one component, containing four $\frac{5}{8}$-11 inserts, must take a full torque of 30,000 in-oz. Installing inserts in these parts has eliminated stripped threads, and at the same time has solved the corrosion problem and provided the necessary loading strengths.

Temperature Resistance

Because of their inherent resistance to high temperatures, wire inserts can be used to provide protection against carburization. Standard stainless steel inserts can withstand temperatures up to 800 F, and higher temperatures can be met by using



INSERTS FORM STEEL THREADS IN PLYWOOD FOR BOLTING TOGETHER WALL PANELS OF ARMY ARCTIC HUTS.



THREAD WEAR IN ALUMINUM TIMING GEAR CASE OF A 160-HP ENGINE IS ELIMINATED BY INSERTS.

BY PERMITTING SMALLER BOSS SIZES, INSERTS CUT WEIGHT OF THE RAWIN METEOROLOGICAL SCANNER.

special materials. In one example, standard inserts are designed into an induction furnace to eliminate seizing caused by exposure to heat. In earlier models, the screws were found to have seized in the threads because of the temperature encountered. To avoid seizing, various classes of thread fit and even brass bolts were tried unsuccessfully.

Vibration Resistance

Some designers use inserts to prevent thread wear caused by equipment vibration. The inserts are automatically self-locking in the female receiving threads because, in the free state, they are slightly larger than the hole and are, therefore, under compression after installation. Also, when inserts are used, the stresses are more evenly distributed, more threads are in engagement and more flank area is in contact —thus vibration between the components and the fasteners does not occur.

One manufacturer uses inserts in the housing of an impact tool. In early models, it was found that steel bolts used to join aluminum housing sections would often cause wear to the tapped aluminum threads because of vibration. In the present design, three sizes of thread inserts are used with lengths one and a half times the bolt diameter to give the desired holding strength without wear. They are installed with a power tool.

Special Applications

Industry has found many ingenious uses for wire thread inserts, usually taking advantage of one or more of the standard attributes plus others of a more special nature.

They are used in an aluminum aircraft lubricating pump to avoid the possibility of metallic chips entering the lubricating system when inlet and outlet fittings are screwed into the pipe thread openings. It was found that metal-to-metal contact between soft threads in the housing and the hard steel threads of the pipe fittings could result in minute chips breaking off the tapped aluminum threads. If carried through the system by the lubricating oil, these chips could lodge under the by-pass mechanism and upset the pressure regulator, causing lubricating pressure to fall below the recommended value. Surfaces of the inserts, on the other hand, will not chip. In addition, the aluminum threads are protected and greater thread strength permits a more secure connection.

Plywood

U. S. Plywood Corporation uses inserts in its insulated sandwich panels to provide steel threads in plywood. These panels—used as wall members for army arctic huts—are made of honeycombed paper, laminated plywood, and sheet aluminum. Corrugated paper, the internal insulating element, is strengthened by laminated plywood edge stiffeners. The entire insulating element is sandwiched between two 1/32-in. aluminum sheets. Assembly of the huts is facilitated by helical-wire thread inserts used as hidden nuts in the ends of each panel.

Inserts are positioned in the plywood edges so that their axes are parallel to the length of the panel. Adjacent panels, assembled at right angles to each other, are fastened together with standard bolts through clearance holes in their 2-in. widths. Inserts also are used to fasten support brackets and equipment to the faces of these panels. When near an edge, the insert is assembled into the ply-

—Continued on page 94

Stephens-Adamson

CONVEYOR, RECENTLY INSTALLED AT B&O ORE DOCKS, CURTIS BAY, MD., HAULS 2000 TONS OF ORE PER HOUR.

Continuous Belt Conveyors

CE exclusive

Can They Be Extended Indefinitely?

WILBUR G. HUDSON
Consulting Engineer

W. G. Hudson, a Cornell alumnus, began his engineering career with Link-Belt Co., advancing to superintendent of construction before World War I intervened. In 1917, he became engaged in shipyard and ship construction as supervisor of the North Atlantic District of the Emergency Fleet Corp. After the war, he served a number of years as chief engineer and assistant to the president of Curtiss Wright Airports Corporation, and later rejoined Link-Belt as chief engineer of the company's Chicago plant.

DEMANDS FOR high capacity materials handling equipment to convey bulk materials over increasingly greater distances have resulted in striking developments in belt conveyor engineering. One example is the conveyor now being installed at the Canton Railroad's ore unloading facilities in Baltimore, Md. Here, two 48-in. belt conveyors, totaling more than 1600 feet in length, will handle 3000 tons of ore per hour. The main belt, running along the docks, is fed by three ship unloading cranes. From this belt, the ore is transferred to the second belt which carries it up a 16-degree incline to a weigh station. The uphill belt operates at a speed of 615 fpm, as compared to 545 fpm for the longer unit.

Another conveyor installation, at the Baltimore & Ohio ore docks in Curtis Bay, Md., is capable of

conveying 2000 tons of ore per hour. Twin traveling unloaders are used to deliver the ore to a 900-ft long, 48-in. belt conveyor operating at 400 fpm. Other significant installations include the 5511-ft long, 48-in. belt conveyor at the new Morrisville, Pa. plant of U. S. Steel Corp., and the 4½-mile beltroad installed for The Ohio Power Company to feed coal from a strip mine to its new Muskingum River Plant. The Muskingum conveyor system, consisting of 14 flights ranging in length from 500 to 2964 feet, twists over hills, spans county roads and a state highway, and bridges the 500-ft wide Muskingum River. The belts are 36 inches wide, travel at 600 fpm, and carry 800 tons of coal per hour.

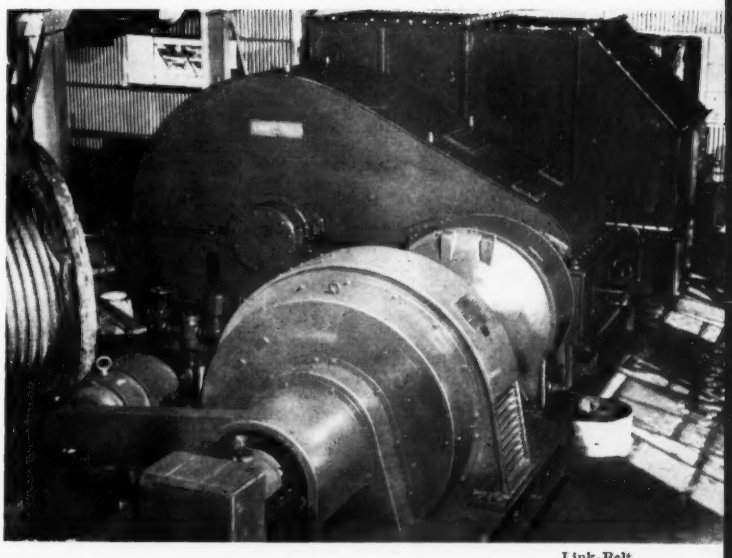
Competition With Railroads

Belt transportation of bulk materials has often been considered as an alternative to rail transportation. An example is the proposed system of parallel, tandem conveyors extending between Lake Erie and the Ohio River at a location convenient to Pittsburgh — a distance of 100 miles. Lake shipments of iron ore would be moved southward, and coal would be moved northward. There is no question about the savings in cost per ton mile, but right of way and legislation difficulties have at least temporarily stymied its construction.

As the capacities and lengths of belt conveyors increase, the advantages of longer single run conveyors assume greater importance. Because of limitations in the standard cotton duck carcass, however, longer flights require a radically different belt construction.

U. S. Steel

SINGLE SPAN CONVEYOR, AT U. S. STEEL'S NEW MORRISVILLE, PA. PLANT, IS 5511 FEET LONG.



Link-Belt

BELT DRIVE AT NATIONAL MINES, SHOWING MOTOR, CLUTCH, DOUBLE-REDUCTION GEAR, AND POST BRAKE.

Belts having a standard cotton duck carcass provide a maximum tension of 60 lb per inch of width per ply, and the number of plies is restricted in order to permit troughing. The number of plies depends upon the width of the belt and the type of fabric used, and seldom exceeds twelve. Thus, the limit for tensile strength is 720 lb per inch of belt width. More important than strength is the amount of stretch encountered, usually figured at about 2 percent of the center-to-center distance of the conveyor. Although the percentage of belt stretch remains approximately the same irrespective of its length, the total amount of stretch on long center-to-center distances becomes excessive, thus creating complicated mechanical problems.

Wire-Reinforced Belts

To make units of far greater length possible, wire-reinforced belts were developed. Multi-stranded, high-carbon steel wires embedded in the carcass take the tension, and eliminate excessive stretching. The wires are brass-plated—then rubber-covered for maximum adhesion. Typical construction for a moderate size wire-reinforced belt would be 32-oz duck and two top plies with a breaker strip — then the usual top and bottom rubber covers. The cable sizes and spacings range from .0937 inches in diameter spaced 10 per inch to .1875-in. diameter spaced 5 per inch. The maximum tension ranges from 600 to 3000 lb per inch of belt width — equivalent to about 50 plies of 42-oz duck.

The opportunities made possible through the de-

Riverlake Belt Conveyor Lines

PROPOSED BELT LINE FROM OHIO RIVER TO LAKE ERIE WOULD HAUL ORE SOUTHWARD, COAL NORTHWARD.

velopment of wire cable reinforced duck are well demonstrated by a single-flight belt conveyor at the National Mines Corporation in West Virginia. In this installation, the belt passes through an intervening mountain via a tunnel to a barge-loading station on the Monongahela River — a distance of two miles. A narrow track alongside the conveyor accommodates a powered service car, and the belt can be stopped by a pull-cord line attached to stop switches at 500-ft intervals. Telephones every 2000 feet provide direct communication with the terminals. Since the belt, alone, costs about $300,000, such precautions against damage are important.

Installation of the belt was rather involved because the maximum diameter of roll which could be shipped was 10 feet, which limited the length of belts to about 1300 feet. Each roll was mounted on a spindle outside, and the belt was pulled into the tunnel after splicing.

The wire-ends in the splices are not joined together. Instead, the tension of one wire-end is transferred to an adjacent group of wires through shear stress in a thin layer of rubber compound. Further along, the tension is transferred back into the continuation of the broken strand. All of the wire-ends are staggered through a section six to eight feet in length, thus each of the wires in the transfer group is handled similarly in a separate zone. When bending around the terminal pulleys, all the junctions are in one plane. The drive pulley must be of sufficient diameter to prevent radial thrust from pulling the cables through the carcass.

Power Requirements

To move the empty belt in the National Mines installation requires 83 hp, and to move the load horizontally requires 60 hp. The discharge end is 135 feet lower than the loading point, providing a gravity assist of 27 hp — thus the total power required to drive the loaded belt is 116 hp. (By test, the motor horsepower was 120.) With a snub of 220 degrees on the lagged head pulley, the maximum tension is 19,600 lb, or 650 lb per inch of belt width (30-in. belt) — well within the limit for a wire cable carcass. It should be noted, however, that the many possibilities of loading, acceleration, and deceleration make it impossible to establish a single, comprehensive figure for maximum tension.

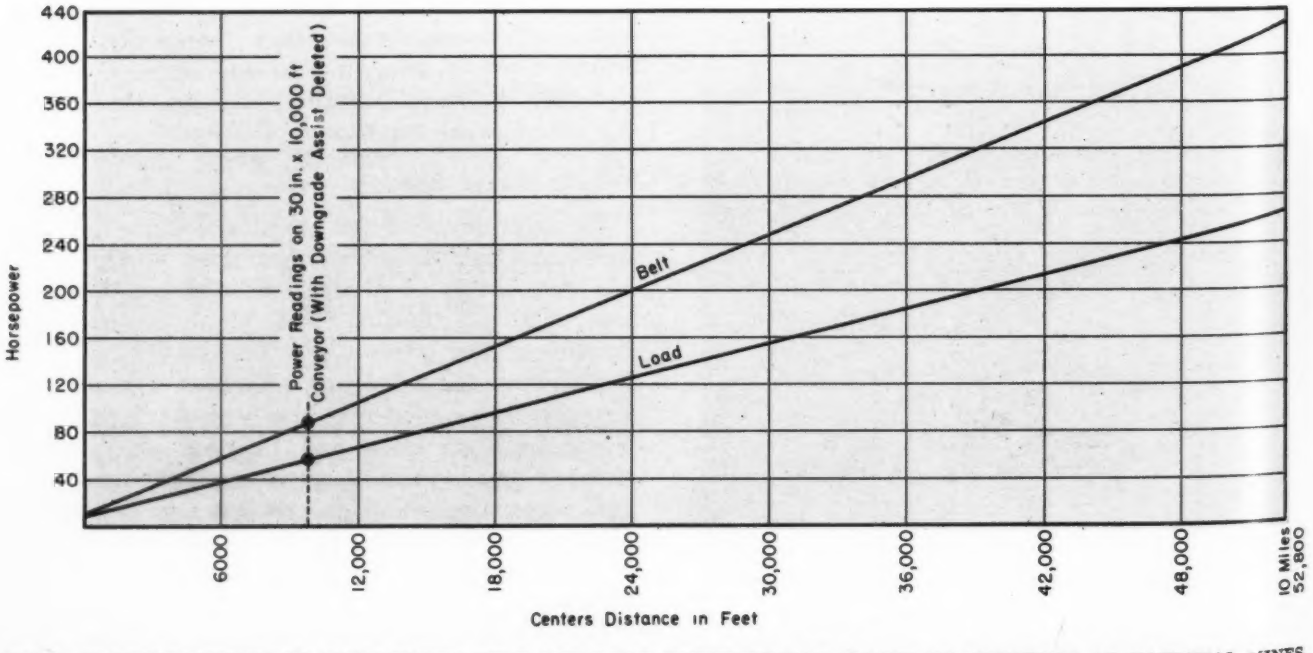
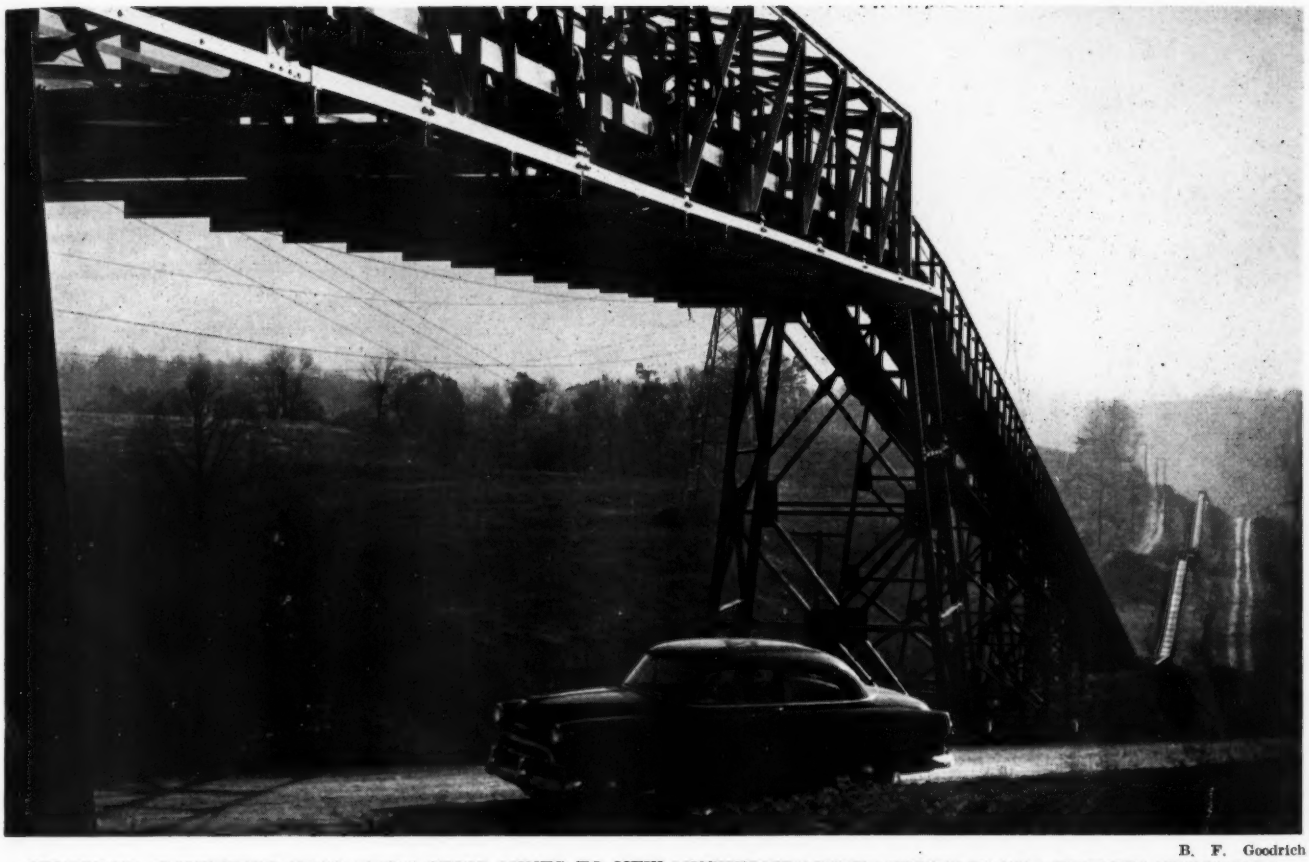


FIG. 1—POWER REQUIRED TO MOVE EMPTY BELT AND LOAD HORIZONTALLY, BASED ON CONVEYOR AT NATIONAL MINES.



B. F. Goodrich

BELTROAD, CONVEYING COAL FROM STRIP MINES TO NEW MUSKINGUM RIVER POWER PLANT, BRIDGES OBSTACLES.

It is interesting to consider what happens if the down-hill slope is increased. The factor for the horizontal movement of the belt and its load does not change. However, the gravity assist is about 0.2 hp per foot of drop, and if the drop exceeds 600 ft, the conveyor will run away when loaded unless it is controlled by dynamic braking or the equivalent. Moreover, since belt slack will accumulate at the lower end, the drive must be shifted to the upper end to provide sufficient traction for control.

While the National Mines installation holds the record for length of a single-span conveyor, the belt tension per inch of width is far below that in several heavy-duty mine slope conveyors. For example, the 42-in. slope conveyor of the Chicago, Wilmington & Franklin Company at Waltonville, Ill. has a length of 3300 feet between centers, and has a lift of 868 feet. The handling rate is 1200 tons per hour at a speed of 625 fpm. The calculated power requirement is:

To move the belt	88 hp
To move the load horizontally	115 hp
To lift the load	1045 hp
Total	1248 hp

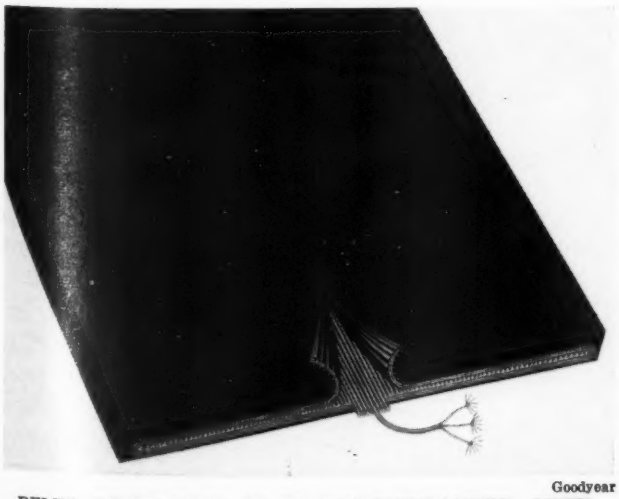
$$\text{Effective Tension} = \frac{1248 \times 33{,}000}{625}$$

$$= 65{,}700 \text{ lb.}$$

The starting tension on the single 72-in. lagged and snubbed head pulley is 95,000 lb, or 2260 lb per inch of belt width.

The belt is driven by a 1500 hp, 900 rpm synchronous motor connected through a dynamic coupling to a double reduction herringbone gear. A post brake on the far end of the head shaft prevents reversal should the current fail. The dynamic cou-

—*Continued on page 92*



Goodyear

BELTS REINFORCED WITH MULTI-STRANDED STEEL CABLES MAKE LONGER CONVEYOR SPANS POSSIBLE.

Oklahoma City Chamber of Commerce

The recently formed Consulting Engineers Association of Oklahoma is dedicated to raising the standards of both its members' products and their practice. Consults in other areas may find such an organization an effective vehicle for professional action.

Oklahoma Consultants Form Association

CE exclusive

To Handle Professional Problems

IN THE PAST three decades, the field of private practice among engineers in Tulsa and Oklahoma City has grown in stature and significance, as have the cities themselves. The problems confronting the consultants in these cities, however, are not unfamiliar to consultants in other areas of the country. They have had to contend with the so-called "free" engineering planning services provided by manufacturers, jobbers, wholesalers, contractors, and utilities. This is not a healthy condition, from the project owner's standpoint, since those providing the free planning services cannot avoid being prejudiced towards their own products or services, thus eliminating competitive bidding.

"Bid shopping," where attempts are made to obtain low competitive fee bids or free preliminary plans from engineers, is another problem faced by the Oklahoma consultants. Relationships between contractors and engineers, and attempts to place limitations on the scope of the engineer's practice, also have created problems.

Discussions of Problems

In getting together to discuss these problems, consulting engineers in both cities found that they were becoming better acquainted with each other's practices and that they were benefiting by it. They felt that it would be highly desirable to continue these meetings and that a formal society would best serve to put the meetings on a permanent basis. Also, the problems of the independent consultants could be better handled by an organization composed of consultants only, rather than one predominantly composed of individuals who too often do not represent the profession in the eyes of prospective clients.

Such an association would serve to safeguard and improve the consulting engineer's professional status and would raise the standards of the individual consultant's practice, thereby increasing the demands for his services. The main efforts would be towards improving the service to the client and broadening the scope of the consultant's responsibility. The association would serve to augment rather than supplement the work of other societies.

The ideas of this group are not original. There are active societies composed solely of consulting engineers in Minnesota, New York, Chicago, and several other parts of the country, and a meeting in St. Louis this summer is being planned to discuss the possibility of organizing similar groups in other states.

The groups in other states were contacted for suggestions and advice, and their experience was taken into consideration when drafting the constitution for the new association.

In January of this year, fifteen charter members representing twelve individual firms ratified the constitution of the new organization, known as the Consulting Engineers Association of Oklahoma. These charter members offer services in widely divergent fields of engineering, including municipal work, heavy construction, building construction (including all phases of structural, mechanical, and electrical design), utility work, petroleum, evaluations, and hydraulics. Although their services vary widely, it should be noted that all of the members are confronted with similar problems since all of

them are engineers engaged in private practice.

Eligibility for membership in the association, according to the constitution, requires "registration, in good standing, as a professional Engineer to practice in the State of Oklahoma, and engagement solely in the profession of Consulting Engineering, maintaining an individual office, or as a principal of a consulting engineering organization." The word principal, meaning one who can establish policy in a company, is necessary so as not to exclude those in incorporated consulting engineering firms.

Membership requirements also are carefully worded to exclude all engineers not solely engaged in consulting engineering work. This provision is important, since it is felt that satisfactory results can be achieved only if the committees handling the problems of private practice are made up of consultants engaged exclusively in engineering work.

Meetings

Regular meetings of the new association are held quarterly, usually rotating the meeting place between the two principal cities of Oklahoma—Tulsa and Oklahoma City. By coincidence, one of the most important engineering projects in Oklahoma has played a significant role in the formation of this new engineering society. Because of the Turner Turnpike, which brings Tulsa and Oklahoma City fourteen miles closer together, and reduces driving time between the two cities by approximately one hour, it is now practical for consulting engineers in one city to attend meetings held in the other.

Government of the membership is vested in an Executive Board, consisting of the President, Vice-President, Secretary-Treasurer, and three members, one of whom will be the immediate Past President. As outlined in the constitution, "the Executive Board, as a body, shall guide and direct the general policy of the Association; shall be the final deciding body and spokesman for the Association on controversial issues; and shall appoint the necessary functional committees and direct their activities."

To make the existence of the new Association known, and to acquaint the public with its purposes, aims, and policies, the constitution has provided for an Education Committee. This committee will conduct talks and prepare newspaper articles and will handle other forms of publicity. It also will be responsible for promoting the goodwill of groups and organizations with whom the members associate professionally and will act as liason with other engineering societies.

Professional Committee

Another committee, the Professional Committee, will develop and conduct a program to uphold the professional standards of the Oklahoma State laws as they apply to the consulting professional engineers. It will investigate all reports of violations and, with the consent of the Executive Board, will report these violations to the proper authorities. In addition, it will be responsible for investigating all allegations of malpractice or unethical advertising, and will recommend any action to be taken by the Executive Committee. The Professional Committee also will study all licensing laws pertaining to the construction industry in order to maintain the scope and public usefulness of the laws regulating the practice of professional engineering.

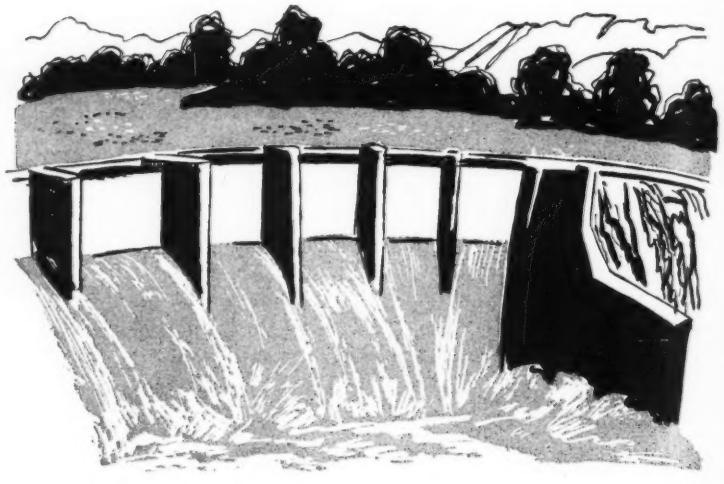
It is the desire of the charter members of the Consulting Engineers Association of Oklahoma to work together to raise the standards of both their product and their practice, thus making their services easier to sell in the face of the various phases of "free" competition. This is the basis of the Association's constitution, and the consultants in Oklahoma hope that engineers in other states will be encouraged to start similar societies.

DeLeuw, Cather & Co.

Inadequate Water Supplies Show Need For Engineering Studies

EACH YEAR sees increasing demands on our public water supplies. Communities not only are faced with a growing consumption of water by the general public, but also modern industrial processes require ever greater quantities.

In the face of increasing demands, the heat and drought of the last several years have caused water supplies to dwindle. Many streams recorded all-time lows during the past winter. Industries have been seriously handicapped by curtailment of their normal water service, and inadequate supply sources and facilities are causing many businesses to look elsewhere when selecting sites for expansion or relocation.



The growing significance of the multi-billion-dollar problem of water supply, conservation, and development is being reflected in widespread consideration of the issue by state legislatures, with the outcome plainly demonstrating that anything approaching an over-all solution must be preceded by extensive engineering studies and continuing efforts to resolve interstate and intrastate controversies.

California

Studies of the Feather River Project now underway in California are expected to be sufficiently completed by June 30, 1955 to enable legislators to decide upon the project's economic feasibility. The $1.2 billion water supply, flood control, and hydroelectric development calls for a 710-ft dam to be constructed near Oroville. Over 3.5 million acre feet of water would be stored, and a canal system would be built to transport several million acre feet of water to Southern California. Engineers have estimated that it would require 368 miles of concrete-lined canal, 65 miles of concrete-covered conduit, and 117 miles of tunnels to deliver the water as far south as San Diego County.

Meanwhile, moves to obtain an appropriation of $75 million to start work on the project, and to obtain a $3.5 million appropriation for purchase of rights of way, were unsuccessful. The entire project is expected to await submission of the feasibility report next year.

Another measure, to be introduced to the legislature by Assemblyman Francis Lindsay, seeks inclusion of $30 million in the state budget for the construction of other water projects in the state, and $2 million for engineering work on a complete water plan. The proposed $30 million, according to Lindsay, will permit work to start on such projects as those sought by the Oroville-Wyandotte Irrigation District in Butte County, and the Tri Dam Project in San Joaquin and Stanislaus Counties.

In another California development, articles of incorporation were filed for the Commonwealth Development Corporation, a non-profit group organized to promote and develop the State's water and transportation resources and facilities.

Colorado

In another significant water supply development, the Colorado State Water Conservation Board approved a $1.5 billion Colorado River storage plan, and also endorsed Denver's request for western slope water from the Blue River near Dillon. A special committee of the Board had earlier received a report, from the Los Angeles engineering firm of Leeds, Hill & Joewett, which declared that construction of adequate storage facilities could provide sufficient water for industrial development of Colorado's western slope and for the proposed Frying Pan-Arkansas and Denver's Blue River diversion projects.

Study of Colorado's water resources, including feasibility of a $100 million project for diversion of western slope water to Denver, through a tunnel under the Continental Divide, is proceeding with the

aid of $100,000 granted by the 1953 legislature.

Other water supply developments in Colorado include a new legislative interim committee, created by the legislature to study utilization of all Colorado water resources including underground water. The principal function of the committee, headed by Senator Donald Brotzman, will be to study what steps can be taken to retain water allocated to Colorado by the 1922 Colorado River compact. Explaining that Kansas and other states have succeeded in tying down their water supplies by law, as a means of protecting present and potential consumers, Brotzman said he is mainly interested in setting up legal safeguards so that no one can claim Colorado's water in case Colorado River allocations are opened for review in 1962.

Kansas

Water appropriation problems in Kansas are being studied by a State Legislative Council committee headed by Representative Sid Jagger. Following the April meeting of the committee, Jagger said, "Kansas is developing a critical water shortage, which is only aggravated by the current drought. It is possible that expansion of some of our larger cities will be curtailed by the availability of water, unless we find a way to get water without jeopardizing the rights of domestic users."

Cooperation in finding emergency water sources for eastern Kansas municipalities was promised by representatives of four state and federal agencies, meeting recently at the University of Kansas. Despite continuing research conducted by both the state and federal geological surveys, it was brought out that closer study is needed for most towns in the critical area. Periodic meetings for exchange of information between the agencies will be held.

In Kansas City, a master plan for the municipal water purification and distribution system is being prepared, at a cost of $50,000, by the engineering firms of Black & Veatch and Burns & McDonnell Engineering Co. The plan includes a new water purification plant, another tunnel under the Missouri River, and expansion and improvement of the distribution system.

Louisiana

In an example of the seriousness of the water supply issue, Louisiana's Governor Kennon recently pointed out that his state, which has always considered that it had an oversupply of water, is now seriously considering the problem of water conservation. There is a growing shortage of water in the rice belt, "with the possibility of a serious condition developing before too many years go by." Consideration is being given to the possibilities of storage basins.

In discussing the situation, Kennon said, "fortunately for Louisiana, the major streams which cross our state offer sources of water supply that make our problems much simpler than those in other states as we get down to specific planning for full use of our water resources."

New Jersey

A proposed tri-state settlement of Delaware River water diversion issues was supported by New Jersey experts at a brief hearing conducted before U. S. Supreme Court special master, Kurt F. Pantzer. Previously, New Jersey and Pennsylvania had opposed a request by New York City, and backed by New York State, for more water from the river. While litigation was pending, however, the three states came up with the agreement now under consideration, and the purpose of the hearing was to show the court that New Jersey's earlier objections are satisfied by the new agreement.

Supreme Court approval must be obtained to permit New York City, now building three reservoirs including a large one at Cannonsville, to take 800 million gallons of water daily from the Delaware River when the reservoirs are completed. New York is now permitted 440 million gallons daily under the terms of a 1931 Supreme Court decree.

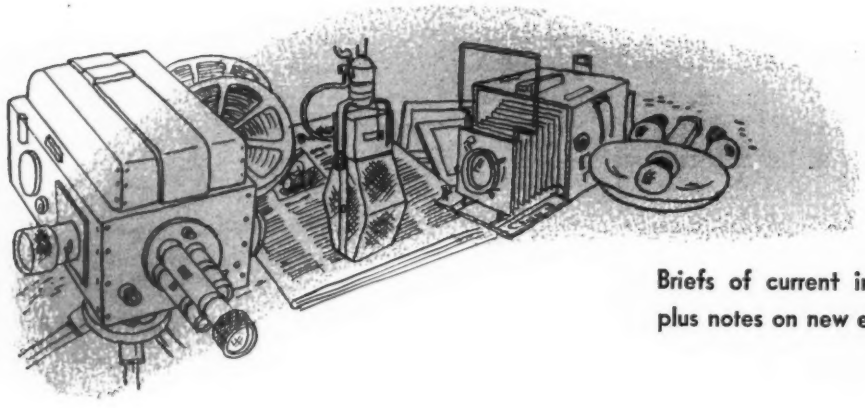
Pennsylvania may, if it wishes, build a dam on the river at Wallpack Bend. New Jersey may share up to 30 percent of the benefits of this dam by paying a proportionate share of its cost. New Jersey may take 100 million gallons of water from the river daily. Although it has been taking water from the river for more than 100 years, this settlement would legalize the State's right to do so without any requirement to replace it in times of drought.

Texas

Plans for the construction of four dams on the upper reaches of the Brazos River, and for a reservoir along the river's route not far from where it empties into the Gulf of Mexico, are being prepared by the Brazos River Authority. This program, estimated at approximately $75 million, initiates the water conservation program of the new agency which was formed by 1953 legislative action calling for reorganization of the former Brazos River Conservation and Reclamation District.

In another Texas development, the Nacogdoches-Lufkin Water Association has advanced a proposal for a privately financed water project designed to insure future industrial and agricultural progress in East Texas. Preliminary plans call for $8 million to $10 million of private capital to develop the water resources of the upper Angelina River.

Meanwhile, local efforts to solve water supply problems are in progress in various sections of the state. In Dallas, a citizens committee is taking action to find a water supply adequate to meet the city's long-range needs. The committee has retained Forrest & Cotton to conduct engineering studies.



NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

Camera Proves Its Worth As Project Tool

Use of the comparatively inexpensive Land-Polaroid camera has reduced litigation and accident claims to a minimum for the Brooklawn Construction Co. of Hartford, Conn. Besides this saving of thousands of dollars and reduced insurance rates, the camera has proved its worth in quickly conveying ideas.

Pictures of the surrounding areas and all relative details are taken at the beginning of every job. Fifteen or twenty pictures are also taken at various stages as the job progresses. Since the picture is produced in sixty seconds, identifying information can be written on the back of the photo immediately. The company also lists the date, all those present at the time the picture was taken, and in some cases has the photo notarized.

Special attention is given to barricades and obstacles which could possibly be a source of trouble. All these photos are stapled to the daily reports and filed by the supervisor on the job. When the job is completed, the photos are transferred to copies of the daily reports in the permanent file at the home office.

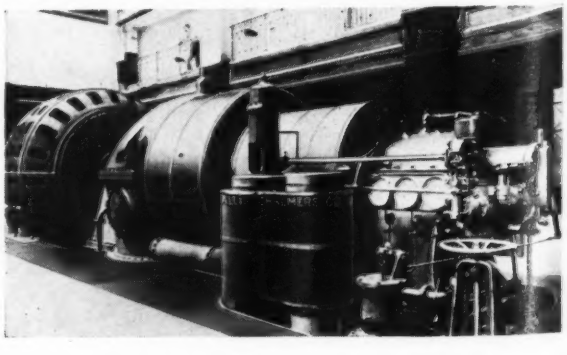
In cases where an ingenious solution has been found or where a special problem arises, photos are taken and sent to the Polaroid Company in Cambridge, Mass. for enlargement. These enlargements are studied at the monthly meetings of supervisors.

Internal Fin Tubing Produced By Extrusion

One of the new types of products made possible by extrusion is tubing with special shapes. Of particular interest to design engineers associated with unusual problems of heat transfer is tubing with integral fins on the inside surface.

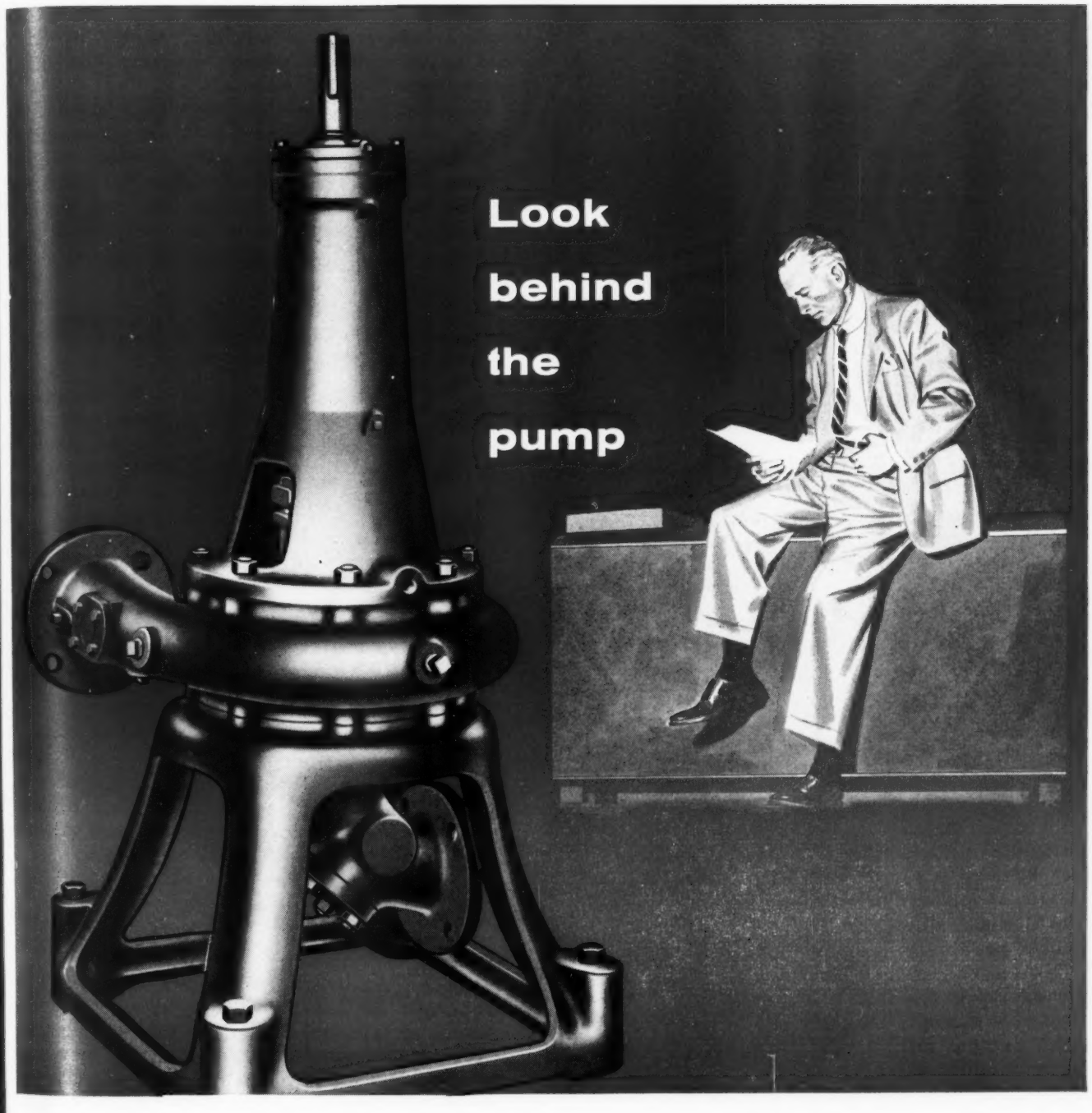
Tubing with ID fins, and greater surface area is produced by the Tubular Products Div. of Babcock & Wilcox Co. of a special heat resisting stainless steel. It is used in a heat exchanger with fire on the outside and gas on the inside.

At present the production of such specialties has passed the purely experimental stage and similar tubing can be produced of a number of steels in a limited size range. Additional information pertaining to special tubular shapes produced by extrusion is available upon request to the division's general sales offices at Beaver Falls, Pa.



Company Celebrates 50 Years In Turbine Business

Fifty years ago Allis-Chalmers Manufacturing Co. entered the steam and hydraulic turbine business with the 5500 kw, 750 rpm, 25 cycle steam turbine unit pictured. It was installed in 1905 in the



How much for maintenance?

In figuring the cost of a trash pump, what do you allow for maintenance ... how much to clear out the trash that clogs the impeller? Will it be daily? Every other day? Weekly?

Or figure it this way. What price a pump that won't clog . . . that will virtually eliminate maintenance? That's why you should figure the Fairbanks-Morse Bladeless Impeller Pump! Its unique whirling tube won't clog . . . there are no blades or projections to catch and hold trash.

This is just one more example of the quality that is Fairbanks-Morse . . . in design, materials, workmanship, a standard of quality that gives you more for your pump dollar. For pump performance you can depend on, rely on the world's largest manufacturer of a complete pump line. See your Fairbanks-Morse Branch or write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

Fifty Years in Turbine Business

—Starts on page 66

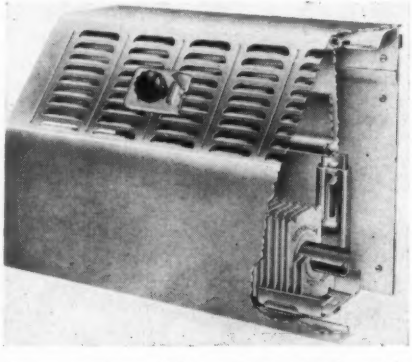
Kent Avenue (now Williamsburg) station of the Brooklyn Transit Development Co.

By way of contrast, this year production is started on the first of two 100,000 kw, 3600 rpm steam turbines with supercharged generators for delivery in 1955 to a midwestern utility.

In addition, a complete line of single-shaft Allis-Chalmers steam turbine-generator units has been carried to 200,000 kw, 3600 rpm. And recent completion of the world's first close-coupled, cross-compound unit, rated 120,000 kw, has set a practical pattern for future giant steam turbine units to 500,000 kw ratings.

In the hydraulic field, current developments include a 150,000 hp, 2500 ft head multi-jet impulse turbine, which is being built by Canadian Allis-Chalmers, Ltd. for the underground Kemano project in western Canada. Several reversible pump-turbine units are installed or in production for pumped storage developments: the first for a domestic installation has just been placed in service at the U. S. Bureau of Reclamation's Flatiron power and pumping plant on the Colorado-Big Thompson project.

Radiant Heat Baseboard Designed for Problem Areas



For hard-to-heat areas such as schools, hospitals, and office buildings, this high capacity, radiant heat baseboard is designed with slope top design for greater effectiveness.

It is fabricated from automobile gage steel with louvered front and covered with a corrosion resistant finish over which any paint may be applied.

The damper, mechanically suspended, uses no springs, chains, or hinges. The damper control will operate positively from any point in the baseboard run.

Manufacturer is Kritzer Radiant Coils, 2901 Lawrence Ave., Chicago 25, Ill.

Latex Emulsion Binder Preserves and Protects Concrete

Styrene-butadiene latex, Pliolite, is playing a key role in overcoming a surface coating problem which has plagued construction engineers for many years.

The liquid rubber, produced by Goodyear Tire & Rubber Company's Chemical Div., added to a cement base, forms an emulsion binder which is said to preserve and protect concrete and other cement-type building materials.

Marketed by Surface Coatings, Inc. under the trade name Surco Yellow-Label, the compound is substituted for much of the water normally used in cement mixes to give the cement unusual toughness and adhesion. It also is said to improve wearing qualities of concrete, mortar, and plaster surfaces by increasing resilience, and water resistance.

Portable Copying Machine Is Low Cost, Self Contained

In two steps a finished copy can be made by an inexperienced operator in less than 45 sec with the new Apeco "Private Eye" Auto-Stat.

Made by the American Photocopy Equipment Co., 1920 W. Peterson Ave., Chicago 26, Ill., the lightweight, portable machine takes little more space than a desk tray. It will handle papers up to 11x17 in. and operates on 120 v ac.

Use of this machine does away with the need for chemical trays and running water. A specially designed plastic solution bottle allows easy draining and storage of the concentrate. The unit is available with a zipper case for easy carrying.

Consulting Firm Lists Errors in Plant Site Selection

Selecting a new plant site is not only one of the most important and critical steps for company management to take, but also one of the most complex. There are innumerable factors that must be weighed and evaluated as to their effect on successful plant operations—factors both economic and social according to A. Kingsley Ferguson, vp of Walter Kidde Constructors, Inc.

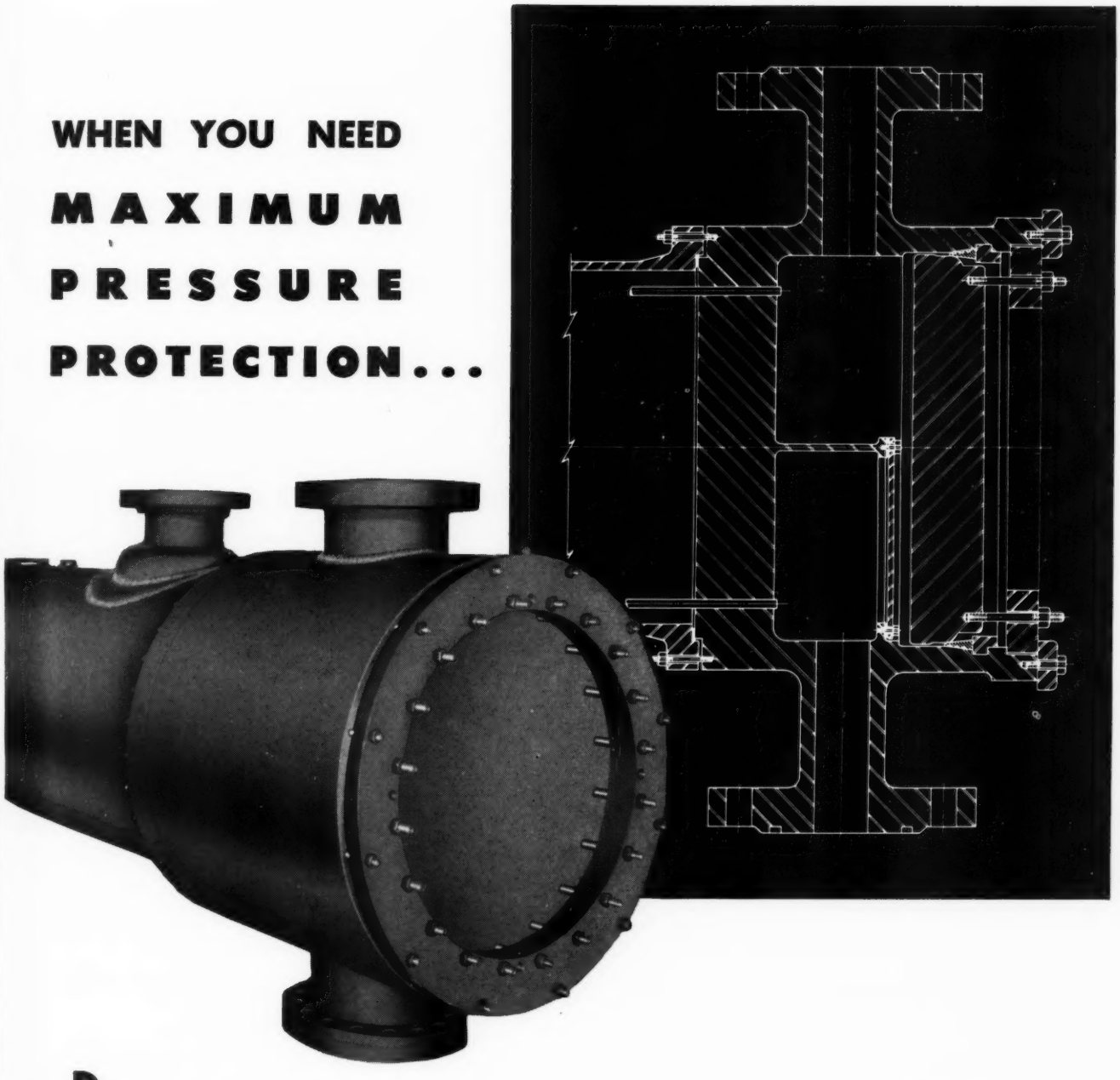
It has been Kidde's experience, based on evaluations of company operations over a period of years, that errors in plant site selection seem to fall into a pattern.

Topping the list is a lack of thorough investigation with consideration of all the factors involved: management brought up through sales may base its decision on distribution facilities; production men may consider only material and labor supply in the area.

Personal likes and prejudices of key executives may actually be allowed to negate site surveys worked out by independent firms or the company's own engineering department.

Again, key personnel may be reluctant to pull up stakes and move their families to a distant part of

WHEN YOU NEED MAXIMUM PRESSURE PROTECTION...



DUE to the unique "Pres-seal" front closure, Whitlock Feed Water Heaters are unsurpassed for high pressure service. This closure design eliminates heavy cover bolting — the hydrostatic load effects its own seal. Channel and tube sheet are a single forging, capable of withstanding the full range of pressures—whether 1,000 or 3,000 psig.

Wherever a high pressure extraction heater is required—in industrial power plants or central stations — it pays to specify Whitlock. We offer standard designs in both U-tube and straight tube constructions, suitable for combinations of desuperheating, condensing, and sub-cooling. Send for complete details. The Whitlock Manufacturing Co., 96 South Street, Hartford 10, Conn. New York, Philadelphia, Boston, Detroit, Chicago, Richmond. Authorized representatives in other principal cities. In Canada: Darling Bros., Ltd., Montreal.

Whitlock

Site Selection Errors

—*Starts on page 68*

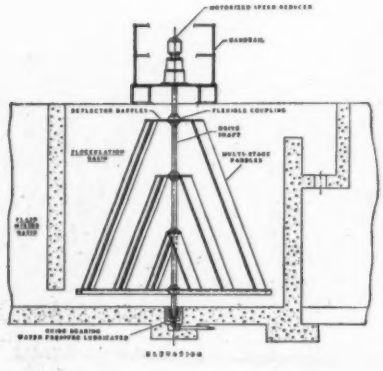
the country even though such a move would contribute to the financial well-being of the company.

The danger of locating in over-industrialized communities is sometimes overlooked because such a community offers incentives of tax exemptions, rent-free buildings, and the like.

Bargain hunting, acquiring an existing structure at what looks like a good price, can easily be a costly mistake. Most manufacturing operations have optimum location and building design which must be considered.

Lastly, because establishment of a new plant involves moving administrative and technical personnel, care must be taken to choose a site with acceptable cultural and educational standards.

Flocculator Provides Roll-Mix Action



For conventional water treatment plants, the Spirol-Mix flocculator is designed for vertical mounting in the flocculation basin. Water enters at the bottom and is gently roll-mixed as it passes upward to outlet at the top.

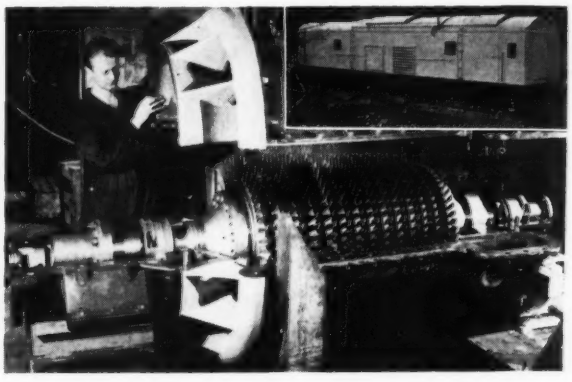
The unit consists of a variable-speed drive mechanism mounted on top of the basin and directly connected by a flexible coupling to a paddle-type mixer assembly within the basin. The mixer assembly consists of a vertical drive shaft to which blade support arms are attached. The drive shaft is held in place at the bottom of the basin by a pressure, water-lubricated guide bearing.

Step arrangement of each set of diagonal blades results in a decrease in total blade area from the bottom to the top of the basin. As the water rises in the basin, it is subject to a decreased rate of agitation, thus preventing the destruction of floc formed in the early part of the operation.

Site-Service Offered by GPU

Industrial Site-Service now offered by General Public Utilities, New York City, provides detailed, confidential information on available industrial sites and buildings in GPU territory (covering 45 percent of Pennsylvania and 43 percent of New Jersey).

Offered through the office of the Director of Area Development, William J. Jamieson, 67 Broad St., N. Y. 4, N. Y., the service includes reports on transportation, natural resources, labor, water utility services, and tax policies.



Railroad Car Contains Gas Turbine Power Plant

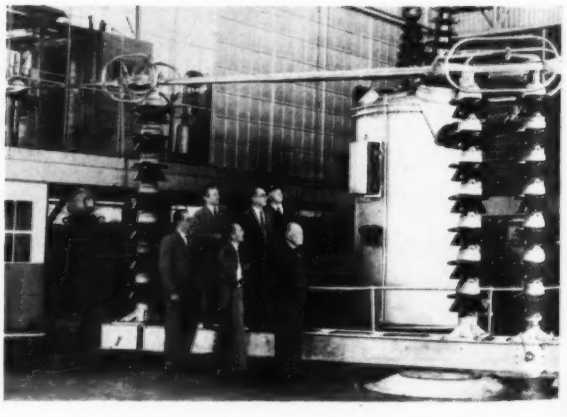
Of interest to the electrical power engineer is a compact Stal gas turbine power plant built into a railroad car to form a mobile emergency service unit for areas where electrical supply has failed. It can also be used during an overhaul or alteration of the regular supply.

The power plant consists of any open cycle gas turbine and a three phase generator, driven by the gas turbine via a gear box. After running speed is reached, the equipment is automatically controlled.

The car includes a machine room for the turbine and generator, an adjacent room for the 90 hp diesel starter engine, and a control room.

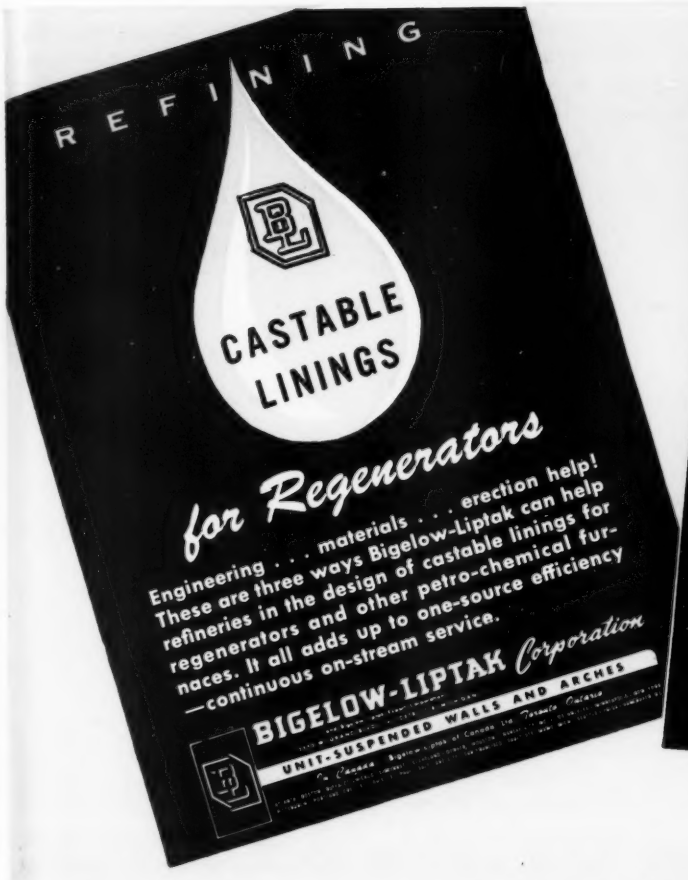
Rating of the plant is 2400 kw with 20 percent efficiency at full load.

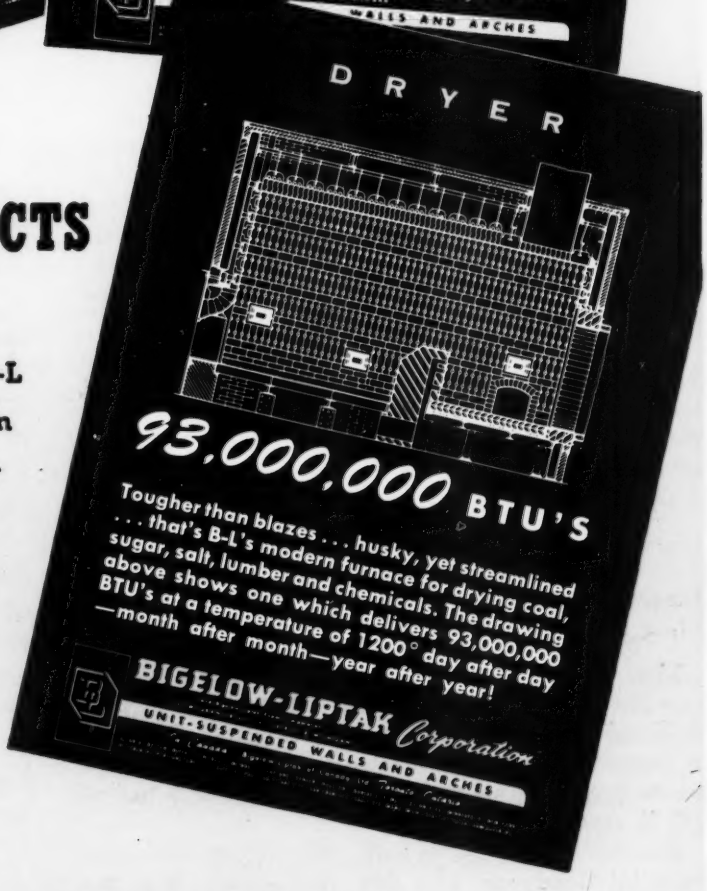
Auxiliary motors and apparatus are fed with 380 v, 3-phase ac. This can be taken from the internal



ENGINEERS INSPECT 330 KV SWITCH

The 330 kv TTR disconnecting switch shown during one of its acceptance tests is one single pole of 34 three-pole switches to be installed at Clifty Creek Station of the Indiana Kentucky Electric Corp., a unit of Ohio Valley Electric Corp. Manufacturer is R&IE Equipment Div. of I-T-E Circuit Breaker Co. Left to right are: R. L. Retallack, AG&E Service Corp. transmission engineer; Arem Foti, R&IE chief engineer; A. C. Bates, R&IE laboratory manager; E. A. Williams, R&IE chief engineer; I. W. Gross, AG&E research engineer; and J. H. Kuhns, R&IE N. Y. representative.





TYPICAL B-L PRODUCTS FOR INDUSTRY

There are many, many applications for B-L furnace construction throughout industry. In steel mills, power houses, refineries and petro-chemical plants, sugar mills, coal mines, glass plants, city incinerators—anywhere in the heat of things—you'll find B-L installations. They're hanging up new records every day—providing top performance at a lower cost per BTU. You can get more information if you write—*today!*

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PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

Power Plant on Wheels

—Starts on page 70

generator, the main generator via a transformer, or from an external network.

According to the manufacturers, Svenska Turbinfabriks A. B. Llungstrom, of Finsborg, Sweden, the plants operate economically with a gaseous fuel or a low grade fuel oil.

Latest Designs and Materials Incorporated in Chlorinator

First of a series that incorporates the latest developments of practical chlorinator design, the A-701 chlorinator features such improvements as dual orifice meter which automatically, or by the flip of a switch, allows feed ranges up to 100 to 1; corrosion resistant materials wherever good structural design permits; linear scale reading of chlorine flow rate; and automatic electric, hydraulic, air, or vacuum control.

Made by Wallace & Tiernan Inc., 25 Main St., Belleville 9, N. J., the chlorinator employs a heavy fiberglass pedestal and an improved design of the W&T glass-enclosed visible-vacuum and water-diaphragm principle of feed control. Capacity is 1000 lb per 24 hr.

Jersey City Station Uses First Commercial Moving Sidewalk

The world's first commercial moving sidewalk, now in operation between the stations of the Erie Railroad and the Hudson and Manhattan Railroad in Jersey City, N. J., is capable of handling 10,400 passengers an hour through the interstation tunnel [C. E. April, '54].

Known as the Speedwalk, the 227-ft conveyor built by Goodyear Tire and Rubber Co. and the Stephens-Adamson Mfg. Co. carries homeward bound New Jersey commuters upgrade from the tube station mezzanine (137 ft of the belt will negotiate a 10 percent grade). Reversible, the conveyor can be operated to take passengers downgrade in the morning hours.

The conveyor utilizes a six-ply rubber and fabric belt, 5½ ft wide and ⅝ in. thick, driven at a speed of 1½ mph.

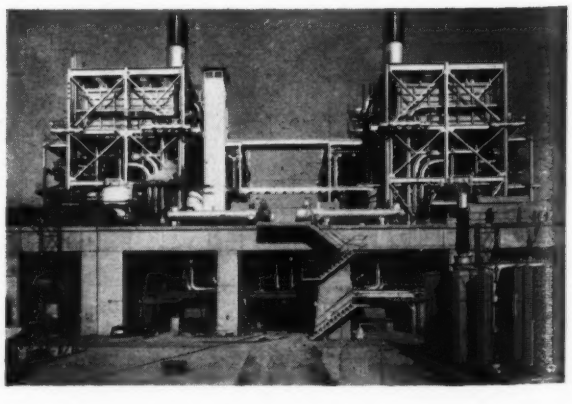
General Electric Co. engineers, working with Goodyear and Stephens-Adamson, developed the electrical system which consists of a fan-cooled motor, a combination reversing starter (fusible type), and a thrustor brake.

Belt Conveyor System Designed for Future Expansion

It is estimated that during 1954 at least two million tons of rich iron ore will be mined and shipped by Orinoco Mining Co., subsidiary of U. S. Steel Corp., from Cerro Bolivar, Venezuela's 1800 ft "mountain of ore."

Puerto Ordaz, at the confluence of the Caroni and Orinoco Rivers, and 91 miles from the mine, has been turned into a 6000 long-ton per hr capacity ore storage and loading station.

The ore handling system at Puerto Ordaz, furnished by Link-Belt Co. as prime contractor, includes facilities for dumping 67 railroad cars per hour, crushing it in primary and secondary crushers to minus five-inch size, and transporting it to a storage pile of 470,000-ton capacity where it is



STEAM POWER PLANT BUILT "OUTDOORS"

Economies in plant cost dictated the "all outdoors" construction of Southern California Edison Company's Etiwanda station, 50 miles east of Los Angeles. The new plant, designed and built by Stone & Webster Engineering Corp. in collaboration with Edison's engineering department, has boilers, turbines, generators, and heaters on a steel and concrete platform open to the sky.

Large photo: 20" x 18" Double Roll Crusher handling Phosphate Rock.

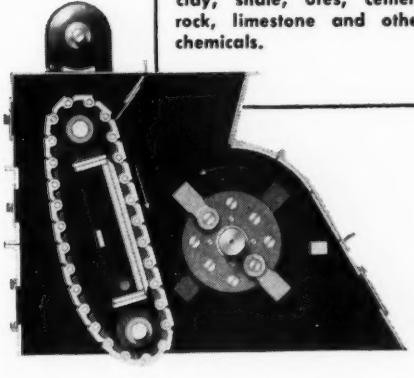
Cross-section: Jeffrey Mud Hog Crusher with traveling breaker plate for handling wet, sticky material such as clay, shale, ores, cement rock, limestone and other chemicals.

JEFFREY crushers and pulverizers solve reduction problems from Alum to Zinc

Jeffrey's Pulverizers and Crushers are the ideal solution to material reduction problems. Hundreds of these standard units are giving efficient, economical service to leaders in your industry. Each is backed by Jeffrey's unequaled experience in this field. Each includes many features only Jeffrey provides.

Whether your material is large or small, wet or dry, Jeffrey has the right machine to crush it . . . ranging from heavy-duty Type B Pulverizers for reducing quarry-size limestone . . . to Junior Pulverizers for laboratory work.

Our laboratories will make a crushing or pulverizing test on your material without charge and recommend the exact type Jeffrey equipment for your requirements.



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FLEXTOOTH® Crushers	Heavy Duty Rock Crushers
Single Roll Crushers	Swing Hammer Shredders
Double Roll Crushers	Swing Hammer Pulverizers
Rigid Hammer Shredders	Metal Turnings Crushers
Impact Type Crushers	Mud Hog Crushers

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PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED

. . .IT'S A JOB FOR JEFFREY!

Belt Conveyor System

—*Starts on page 72*

stocked out by means of a self-propelled, 400-ft-span belt conveyor bridge.

The continous sampling system takes 60 tons of ore off the belt each hour and after grinding and quartering retains a representative five-pound sample from each hour's run. Overage is returned to the conveyor system.

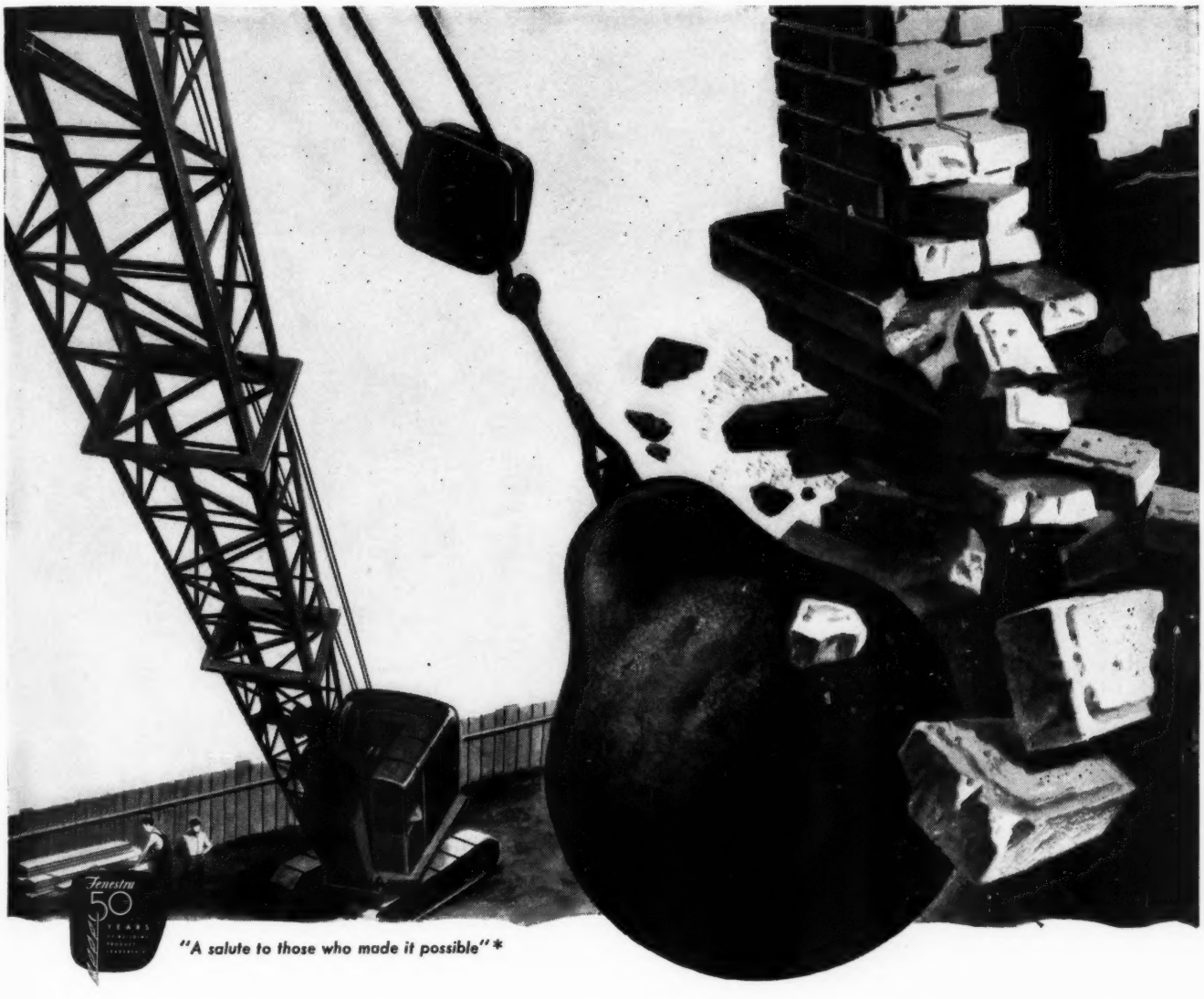
When a ship is to be loaded, the ore is reclaimed automatically by means of four traveling rotary plow feeders which are located in two tunnels beneath the storage pile, and transported by belt conveyor to the dock, weighed and sampled en route, and loaded into the hold of the ship.

The traveling shiploader, which can serve vessels of up to 50,000-tons capacity, has a loading boom that can be raised or lowered to compensate for 39-ft seasonal rise and fall of the river level.

One man in the shiploader operating cab controls the speed and capacity of the entire reclaiming system, from storage pile to ship, by means of a variable voltage electrical hookup. This arrangement provides speed variations for trimming ship and reduces the cumulative delay resulting from starting and stopping the various units in sequence.

Provision has been made for increasing the capacity of the reclaim system to 12,000 long tons per hr through future installation of two additional tunnels beneath the stockpile, a duplicate conveyor system from storage pile to dock, and a second shiploader.

The design of the system was developed by Link-Belt in cooperation with Orinoco Mining Co. engineers. Subcontractors on the project were McDowell Co., S. A., of Caracas, who handled the erection, and Wellman Engineering Co., who built the car dumper, belt conveyor bridge, and shiploader. International General Electric Co. furnished the electrical controls, and Allis-Chalmers Manufacturing Co. furnished the crushers. ▲▲



"A salute to those who made it possible" *

WILL YOUR BUILDING DIE OF ELECTRICAL STARVATION?

Will it be old *electrically* before it's completed?

Or will it be productive beyond its normal span because of its electrical flexibility? It *can be* — with Fenestra-Nepco Electrifloor — the structural floor system in which the sheet steel cells are used as electrical raceways.

With this advanced new floor system, new outlets can be installed *any time* . . . in *any* or *every* square foot of floor space. Your floor will welcome every future electrical demand.

And this new floor system saves building time, labor, materials and money!

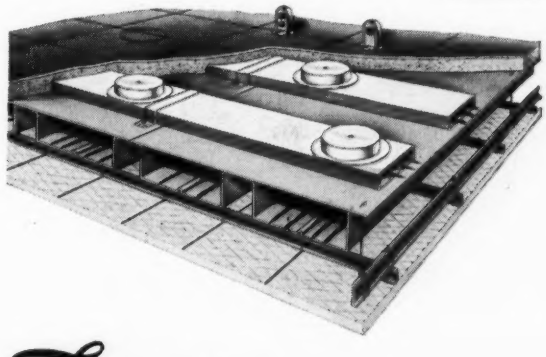
On one job, 1,000 tons of structural steel were saved because of Electrifloor's combination of great strength with light weight. Foundation costs were also cut.

On a rush job, it saved 6 months' building time—as many as 7 floors went in at once. As soon as a few of the cellular floor panels were laid and interlocked, they served as material storage space and working platform.

Fenestra-Nepco Electrifloor was developed jointly by Fenestra* (Detroit Steel Products Company) and Nepco (National Electric Products Corporation)—two great names in the construction field.

If *you* want to protect *your* building investment write to Detroit Steel Products Co., Dept. CE-6, 3443 Griffin Street, Detroit 11, Mich.

*Trademark



* Your need for electrical flexibility for the present and future of your building encouraged Nepco and Fenestra to develop Electrifloor . . . a great advancement in building products.

Fenestra Nepco | ELECTRIFLOOR

MEN IN ENGINEERING

★ The honorary degree Doctor of Engineering has been awarded by the University of Colorado to Victor E. Vallet, pres of Giffels & Vallet, Inc., L. Rossetti, for outstanding service in the integration of architectural design with engineering practice.

★ Dr. Kenneth H. Kingdon, one of the key scientists in early work which led to the development of atomic energy, is appointed manager of the new Nucleonics and Radiation Section of the General Electric Research Laboratory, and Dr. Ernest E. Charlton is appointed consultant on radiation to the newly formed section.

★ Harry Winne, retired vice president in charge of engineering of the General Electric Co., receives the National Society of Professional Engineers' 1954 Award in recognition of meritorious service to the engineering profession.

★ Election of Gordon P. Larson of Los Angeles to the presidency of the Air Pollution Control Association is announced. He succeeds Thomas C. Wurts of Pa. Other officers elected were five directors: Basil Horsfield, Reynolds Metals Corp.; Benjamin Linsky, Bureau of Smoke Inspection & Abatement, Detroit, Mich.; Herbert H. Ulrich, Chief Smoke Regulation Engineer, Omaha, Nebr.; Elmer P. Wheeler, Monsanto Chemical Co.; H. A. Belyea, Industrial Hygiene Engineer, Ontario Depart. of Health, Toronto, Ontario, Canada.

★ Edward W. Randall becomes head of Technical Survey activities for Designers For Industry, Inc. Jay C. Standish, administrative assistant to the chairman of the board is also elected to the post of secretary of the company.

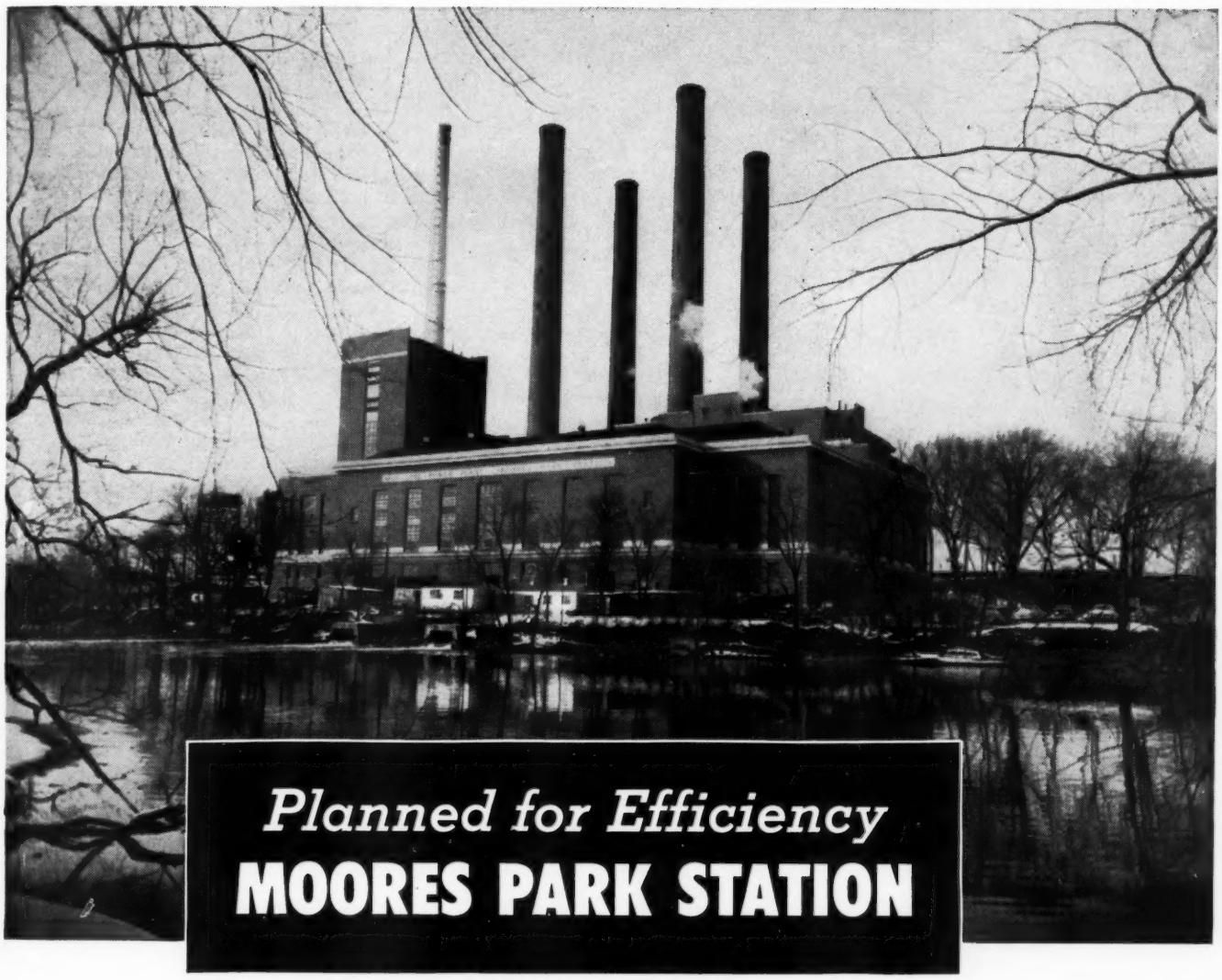
★ Michael Baker, Jr., president of the consulting engineering firm of Michael Baker, Jr., Inc., has received a 1954 Horatio Alger Award, in recognition of a career closely paralleling the Alger stories. International representative for Baker will be Leon Phillip O'Connor.

★ In bestowing the engineering profession's Washington award on Dr. Lillian Gilbreth, the Western Society of Engineers cited her for "outstanding contributions to engineering and scientific management and for her unselfish devotion to the problems of the handicapped."

★ Ebasco Services, Inc. announces appointment of John J. Reilly as chief appraisal engineer succeeding W. M. Black who becomes consulting appraisal engineer. A director and general consultant of the company, Carl H. Reker, has been elected president of the Yale Engineering Assoc.

★ A team of seven U. S. engineers has been retained by the Foreign Operations Administration to evaluate accomplishments of certain major industrial projects in Western Europe and Africa. The team will be headed by Maurice R. Scharff assisted by Franklin J. Leerburger, both New York consulting engineers. Other members are: Leighton F. Korb, formerly with Freyn Engineering Co.; Max H. Forester, Pittsburgh Consolidation Coal Co.; Burnside R. Value of Seelye, Stevenson, Value and Knecht; William Ginsberg of William Ginsberg Assoc.; and Cornelius S. Snodgrass, petroleum consultant of Washington, D. C.

★ A modern, privately financed petroleum butadiene plant is being considered for installation in Texas, according to backers of the project: William R. Staats & Co. of Los Angeles; Purvin & Gertz of Dallas, Texas; and other interests. The



Planned for Efficiency
MOORES PARK STATION

Moores Park Station of the Board of Water and Electric Light Commissioners, Lansing, Michigan. Consulting Engineers: Burns and Roe, Inc., New York City. Present capacity: 40,000 kw. Future capacity: 160,000 kw.

Efficiency was the keynote in planning the coal-handling system for the Moores Park Station. And, with the accumulated experience of the Lansing, Michigan, Board of Water and Electric Light Commissioners . . . the consulting engineers, Burns and Roe . . . and Chain Belt Company Conveyor Engineers . . . the system was bound to set a new high in efficient operation.

For, when you back up the dependability and top quality of Chain Belt Coal Handling Equipment with the planning skill of this team of experts, you have a combination that results in dependable, low-cost coal handling for years to come.

If you're planning a new coal-handling system, or considering the expansion or modernization of your present one, why not put the Chain Belt Conveyor Experts to work on your team. Just contact your nearest Chain Belt District Sales Office or write direct to Chain Belt Company, 4797 W. Greenfield Ave., Milwaukee 1, Wisconsin.

CHAIN BELT COMPANY

District Sales Offices in all Principal Cities

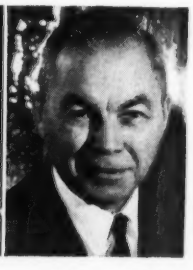
MEN

—Starts on page 76

Fluor Corporation, Ltd., Los Angeles, will make preliminary estimates and economic studies of the project. Purvin & Gertz, Dallas, Texas, is acting as consulting engineer.

★ Selection of the Baton Rouge, La., engineering firm of Barnard & Burk to handle engineering work in connection with construction of a 30-in. natural-gas pipeline from Louisiana to the East Coast is announced. Texas Gas & Oil Co. of Houston, organized to construct and operate the huge line, will be headed by J. O. Mack.

CISLER



LANDRIGAN

★ Detroit Edison Co. president Walter L. Cisler takes over the duties of chairman of the board upon retirement of Prentiss M. Brown. Replacing executive vice pres. Arthur S. Albright, also retiring, will be Charles R. Landrigan.

★ Erection of a 40,000-sq-ft manufacturing plant for the newly-organized New Jersey Shale Brick & Tile Corp. has been started by the Luria Engineering Co.

★ Appointment of H. A. Denny as vice president and assistant general manager of the Engineering and Construction Div. of Koppers Co., Inc., is announced along with several other promotions. A. B. Fisher, Jr. will be general superintendent of construction, George P. Wilson will be production manager, and Richard W. Vollmer will assume the responsibilities of manager of the chemical and gas department of Engineering and Construction Div.

★ The Non-Destructive Testing Dept. of Sam Tour & Co., Inc. is now headed by J. K. Bell. Bell is also the representative of Tour on the American Society for Testing Materials Committee E-7 and subcommittees 2, 3, 5, and 6.

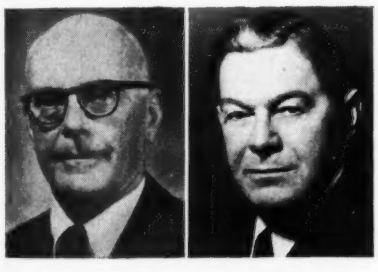
★ Robert M. Cornforth is appointed manager of refinery sales for Kaiser Engineers Div. of Henry J. Kaiser Co. Cornforth, who will specialize in matters pertaining to the

petroleum industry, was formerly vp in charge of sales for the W. M. Barnes Co. of Los Angeles and Toronto, Canada.

★ George A. Rietz, named manager of a newly-established grants and services section in the General Electric Company's Educational Relations Services Dept., will be responsible for G-E's expanding program with educational institutions and groups.

★ Vitro Corp. of America appoints Glen W. Wensch metallurgical engineering representative of the corporation in the atomic power reactor project now under study by 26 associated firms, led by Dow Chemical Co. and Detroit Edison.

★ The Trinks Award for achievement in industrial heating has been received by five engineer-executives: Matthew Holmes Mawhinney, consulting engineer to the steel industry; W. M. Heoburn. Surface Combustion Corp.; Dr. R. P. Heuer, General Refractories Co.; Frederic O. Hess, Selas Corp. of America; and Lee Wilson, Lee Wilson Engineering Co., Inc.

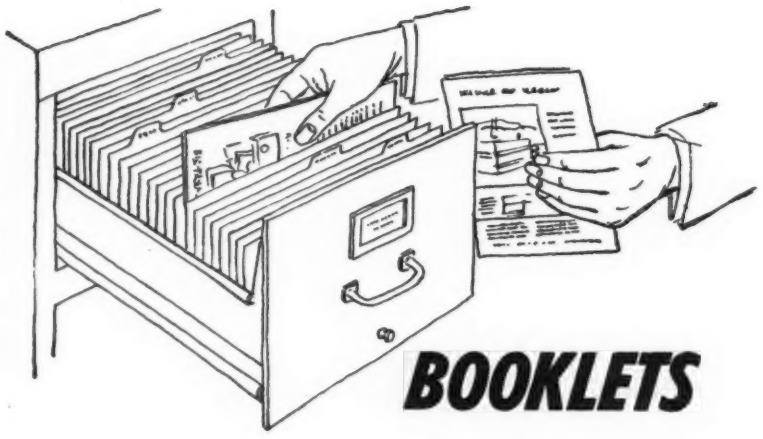


MAWHINNEY GOULD

★ The Metropolitan Section of the American Society of Civil Engineers announces selection of Richard H. Gould as Metropolitan Engineer of the Year. He is a retired director of the Division of Sewage Disposal, New York City Dept. of Public Works, and is currently associated with Greeley and Hansen, Consulting Engineers.

★ Elected as a Fellow of the American Society of Mechanical Engineers are: Ralph M. Hardgrove, research consultant for Babcock & Wilcox Co.; and Walter P. Gavit of United Engineers & Constructors, Inc. Hardgrove is cited for his work in the field of pulverized-coal firing and steam generation, and Gavit for his activity in the technical development of the power industry.

★ Formation of Brown, Blauvelt & Leonard, chemical and industrial engineers, with offices at 470 Fourth Ave., New York City, is announced by Francis L. Brown, Harold A. Blauvelt, and Jackson D. Leonard.



BOOKLETS

Personal copies of booklets can be obtained by writing directly to the manufacturers

HEAT TRANSFER EQUIPMENT—22-page brochure M304 carries you through the operations required to manufacture this company's condensers, heaters, evaporators, coolers, and refrigeration equipment. The story starts before the turn of the century when this company designed and constructed distillation equipment primarily for industrial alcohol. *Lummas Co., Dept. CE, 385 Madison Ave., N. Y. 17.*

"PIPELINE PROGRESS," Ten-page book describes 45 years of pipeline installation work done by this company. It gives a brief history of the organization with photographs showing actual pipeline installations for the many and varied projects in all parts of the country. *C. N. Flagg Co., Inc., Dept. CE, Meriden, Conn.*

ROOFING AND SIDING—Advantages, composition, colors, and methods of installing V-CORR, and enamel-on-steel roofing and siding material are discussed in eight-page bulletin. Engineering data and scale drawings are included. *Toledo Porcelain Enamel Products Co., Subsidiary of Bettinger Corp., Dept. CE, Toledo.*

ROLLING DOORS—31-page bulletin 79 gives helpful information in not only comparing the advantages of the different styles of upward acting types of doors, but also dimensional information necessary in planning the use of such doors. Included are fire doors and shutters, bi-fold, steel rolling service, and Rol-Top sectional overhead doors. *Kinnear Manufacturing Co., Dept. CE, Fields Ave., Columbus 16, Ohio.*

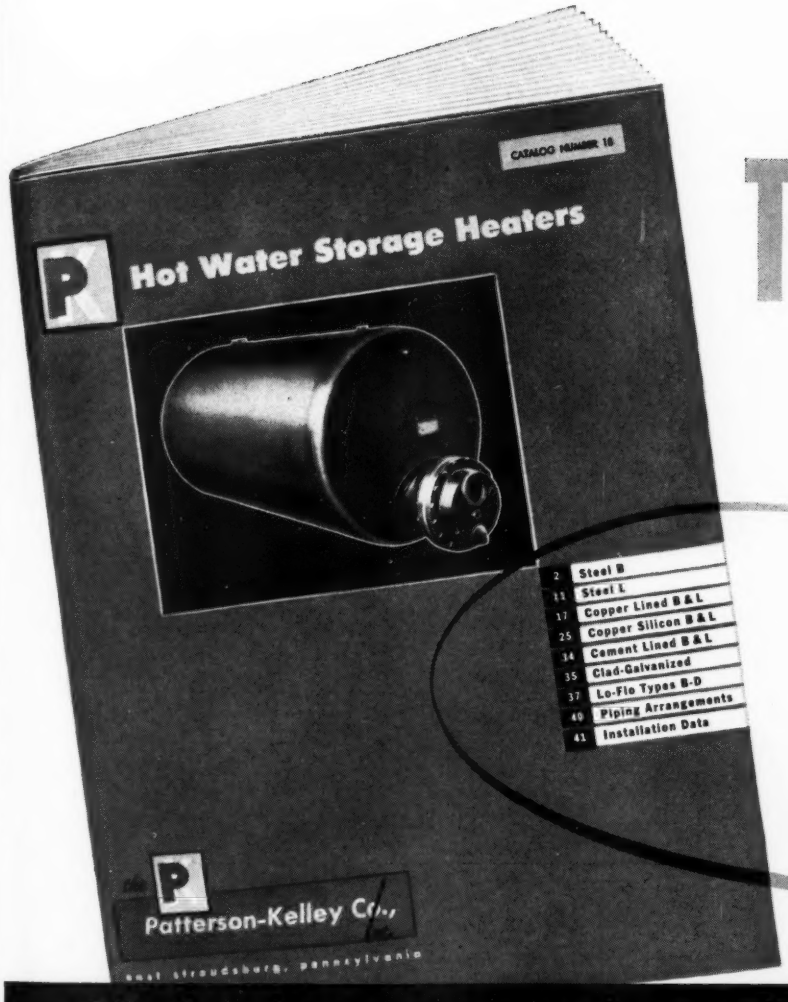
ENGINEERING SERVICE — Ten-page brochure outlines services offered by this engineering organization. Special projects are discussed with the listing of the clients for whom the groups have completed projects. *Barnes & Reinecke, Inc., Dept. CE, 230 East Ohio Street, Chicago 11, Ill.*

"HEAT RESISTANT and Corrosion Resistant Alloy Castings in Industry," bulletin A-141, 48-pages, discusses typical compositions regularly produced, with applications, limitations, and the types of service for which they are suitable. Tables list principal Alloy Casting Institute designations as well as certain proprietary alloys. *International Nickel Co., Inc., Dept. CE, New York 5, N.Y.*

INDUSTRIAL PHOTOGRAPHY — For users of photographic paper for reproduction of documents, charts, and graphs, this booklet contains detailed description of this company's reproduction papers and their applications. Recommendations for proper safelights, exposure, and processing are given, along with a listing of processing formulas for these papers. *E. I. du Pont de Nemours & Co., Photo Products, Dept. CE, Wilmington, Del.*

INDIRECT HEATING — 24-page catalog CH-532 contains valuable handbook data on the subject of indirect heating, including the Chinook principle of a "pipe within a pipe." Also included are tables of heater capacities, performance curves, physical data, casing dimensions, friction losses, and steam properties. *Bayley Blower Co., Dept. CE, 6610 S. 66th St., Milwaukee 14, Wis.*

PACKAGED WATER TUBE steam generators Type MH, furnished for oil or gas firing or both, with automatic, semi-automatic, or manual combustion controls, are covered in detail in 16-page bulletin MH3-54. A dimension table for 13 standard sizes ranging in capacity from 10,000



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All the facts you need to select and install hot water storage heaters . . . the most economical way to provide for peak hot water demands.

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A basic reference work for architects, engineers and contractors selecting and installing hot water systems, and for users of hot water for process and service.

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BOOKLETS —Starts on page 80

to 40,000 lb of steam per hour is included. *Union Iron Works, Dept. CE, Erie, Pa.*

TELEMETERING—Two wires do the work of sixty in a new and simple telemetering system developed by this company, according to this four-page folder. Known as the Telestep, the unit is for the automatic remote control of municipal and industrial water and sewage treatment equipment. Sample problems and solutions are given. *Automatic Control Co., Dept. CE, 1005 University Ave., St. Paul 4, Minn.*

"FUNDAMENTALS OF TURBINE SPEED Control," 32-page brochure H-21 is an educational piece intended to clarify the operation of common types of automatic speed control for steam turbines. Simplified diagrams illustrate operating principles of actual control systems. *Elliott Co., Dept. CE, Jeannette, Pa.*

"SOLVING STEAM TRAP Problems," revised 36-page catalog T-5M254 includes information on the new combination float and thermostatic traps, which vent air in one-eighth the time of standard inverted bucket traps. The booklet also tells how to calculate condensation loads and select traps for all classes of equipment. *V. D. Anderson Co., Dept. CE, 1935 W. 96th St., Cleveland 2.*

"IN-PLANE BENDING Properties of Welding Elbows," 23-page bulletin 534, is a reprint of ASME Paper 53-A-70. This paper provides design engineers with accurate, experimentally derived flexibility and stress intensification factors applicable to welding elbows commonly

used in high pressure steam systems. *Taylor Forge & Pipe Works, Dept. CE, P. O. Box 485, Chicago 90.*

CORROSION RESISTANT MATERIAL—Four-page bulletin 100 defines the serviceability, cost, and life of each material in a line of corrosion resisting coatings. The practical limitations of each coating, lining, and surfacing material are made clear by tabulated data. *Mullins Non Ferrous Castings Corp., Carboline Co. Div., Dept. CE, 331 Thornton Ave., St. Louis 19, Mo.*

FLOW METERS—Flow approximation data and installation information make 56-page catalog 2320 a valuable reference manual. It describes all types of flow meters made by this company's Industrial Div., including instruments of both evenly graduated and square root types. *Minneapolis-Honeywell Regulator Co., Industrial Div., Dept. CE, Station 64, Philadelphia 44, Pa.*

AIR HANDLING—Using these two 40-page catalogs, 1620 on heating and ventilating units, and 1630 on air conditioning units, engineers can competently and intelligently plan, specify and order the proper units to solve almost any problem involving the moving, heating, or cooling of air. *Westinghouse Electric Corp., Sturtevant Div., Dept. T-126, CE, 200 Readville St., Hyde Park, Boston 36, Mass.*

WITH THIS SLIDE-CHART calculator you can quickly estimate pressure drop and proper size steam valve needed for any pressure up to 1500 psi. Full operating instructions and necessary technical data are included. *Golden-Anderson Valve Specialty Co., Dept. CE, 1273 Ridge Ave., Pittsburgh 33, Pa.*

SMALL BOILERS available in 15 to 40 hp for heating and processing are introduced in a four-page bulletin AD-134. Advantages such as the new hinged front and rear doors, forced draft air system, four-pass construction, and electric control panel are shown by means of drawings and photographs. *Cleaver-Brooks Co., Dept. CE, 326 E. Keefe Ave., Milwaukee 12, Wis.*

"THE DORRCO Aldrich PeriFilter System," six-page folder 9042, describes the physical characteristics, types, and sizes of this new water treatment system as well as its instrumentation, operation, applications, and advantages. *The Dorr Co., Dept. CE, Barry Place, Stamford, Conn.*

LIGHT METALS RESEARCH—Sixty-five years of leadership in light metals research set the theme for

BOOKLETS —*Starts on page 80*

"Research at Alcoa," 54-page booklet AD-316. It describes the work of the Aluminum Research Laboratories and also provides useful bibliography of technical articles about aluminum. *Aluminum Co. of America, Dept. CE, 1501 Alcoa Building, Pittsburgh 19, Pa.*

"ENGINEERED MATERIALS Handling Systems," 32-page bulletin 400 describes and illustrates specific industrial examples of this company's material handling system. It gives technical information on enclosed elevator for handling chemicals, and covers screw, vibrating, flight, slat, and belt conveyors, plus special purpose units such as chemical breakers, dust-tight gates, and screw feeders. *Gifford-Wood, Dept. CE, Hudson, N. Y.*

MEASUREMENT AND CONTROL—Brought up to date and completely revised, 33-page bulletin 004 supercedes an earlier volume produced in 1950 on this company's equipment for the measurement and control of liquids and gases. Units described are applicable for water and sewage works, power and processing industries. *Simplex Valve and Meter Co., Dept. CE, 68th and Upland Sts., Philadelphia 42, Pa.*

REFRACTORIES—Designed to afford helpful information in handy reference form, this 126-page booklet embraces all of the company's products in addition to providing tables, charts, and other valuable data for those specifying fire clay refractories. The handbook is sectionalized for greater convenience. *Walsh Refractories Corp., Dept. CE, 101 Ferry St., St. Louis 7, Mo.*

FILTRATION—How filtration of water, or other liquids for industrial use can be obtained simply, economically, and efficiently by means of this company's diatomite filters is described in Bulletin WC-115. Text, photographs, and schematic diagrams show typical arrangement of the unit. *Graver Water Conditioning Co., Division of Graver Tank and Manufacturing Co., Inc., Dept. CE, 216 West 14th St., New York 11.*

"PERFORMANCE OF WIRE MESH Demisters," 25-page reprint presents case histories from the chemical, petroleum, and petrochemical industries which show how the units are being used to eliminate overhead losses, or increase quality of the overhead product, while permitting operation at vapor velocities which otherwise would be excessive. *Otto H. York Co., Inc., Dept. CE, 69 Glenwood Place, East Orange, N. J.*

MUNICIPLE AND INDUSTRIAL water supply treatment systems which continuously soften by base exchange resin and continuously regenerate the resin with brine are explained in four-page bulletin 4083. A graphic wash drawing and photograph show basic components of the units known as the Dorrco Hydro-Softener. *The Dorr Co., Dept. CE, Barry Pl., Stamford, Conn.*

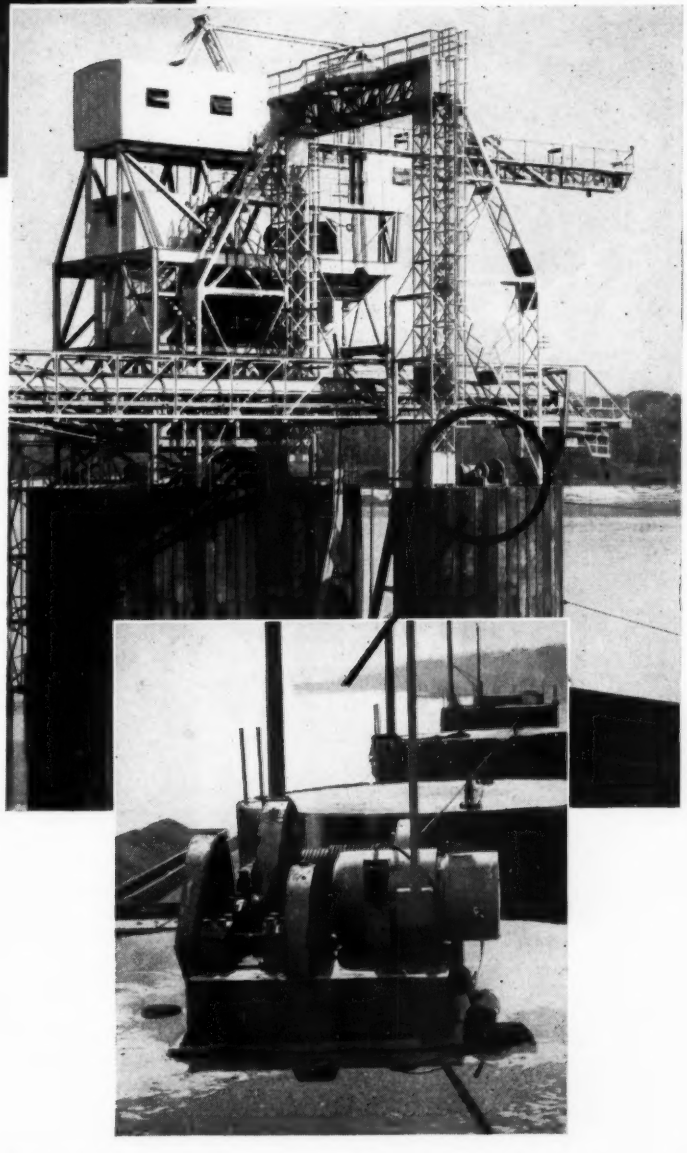
OIL FILTERS for high flow rate filtration of internal combustion engine lubricating oil, using by-pass, shunt, or full-flow systems are described in four-page folder F-154. Phantom views show unit with and without heaters. Flow-pressure—viscosity data for various cartridges may be obtained from the graph in the bulletin. *The Hilliard Corp., Dept. CE, Elmira, N. Y.*

OIL, PUMPING, and straining units for stationary plants built into a unit on one base pan or a series of base pans, are described in six-page catalog 9429. The different arrangements necessary to meet individual boiler plant requirements are discussed in detail along with illustrations. *Combustion Equipment Div., Todd Shipyards Corp., Dept. CE, 81-16 45th Ave., Elmhurst, Queens, N.Y.*

"IF YOU USE WATER," 24-page booklet IE-9, discusses more than a dozen important water treatment processes now serving industry—

Clyde Unloader with patented "Fleet-Block" Reeving moves materials fast in St. Louis

The St. Louis plant of the Great Lakes Carbon Corporation is well serviced by Clyde equipment. Two pier-mounted Clyde Barge Movers position the loaded barges. The Clyde Unloader transfers coal from barge to tower hopper. Then it is transported by conveyor to loading hopper where coal cars are spotted by a Clyde Continuous Rope Car Puller.



Clyde Unloader is a modern, highly efficient machine specially designed for high speed handling of bulk materials such as coal, ore, grain, chemicals, etc.

FASTER CYCLES . . . GREATER PRODUCTION

Clyde's patented "Fleet-Block" reeving provides horizontal bucket travel as trolley traverses in or out on the boom. This permits the use of light weight, large capacity standard buckets with larger pay loads. No need of heavy, expensive, "fleet-through" buckets. No bucket drop to overcome as trolley nears hopper . . . faster, easier operation with less horsepower consumption.

SIMPLIFIED CONTROLS . . . EASIER OPERATION

Two master switches control bucket hoisting, lowering and trolley travel. Push buttons in top of each lever give thumb control of bucket holding and closing lines. Limit switches protect against accidental over travel and provide safe and foolproof operation.

Many other important features of Clyde Unloaders invite your careful study for large volume material handling applications.

WRITE TODAY for complete information. The services of our skilled Engineering Department are available to help you profitably solve your material handling problems.

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CLYDE IRON WORKS, INC.

Established in 1899

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Subsidiary of Barium Steel Corp.

BOOKLETS —Starts on page 80

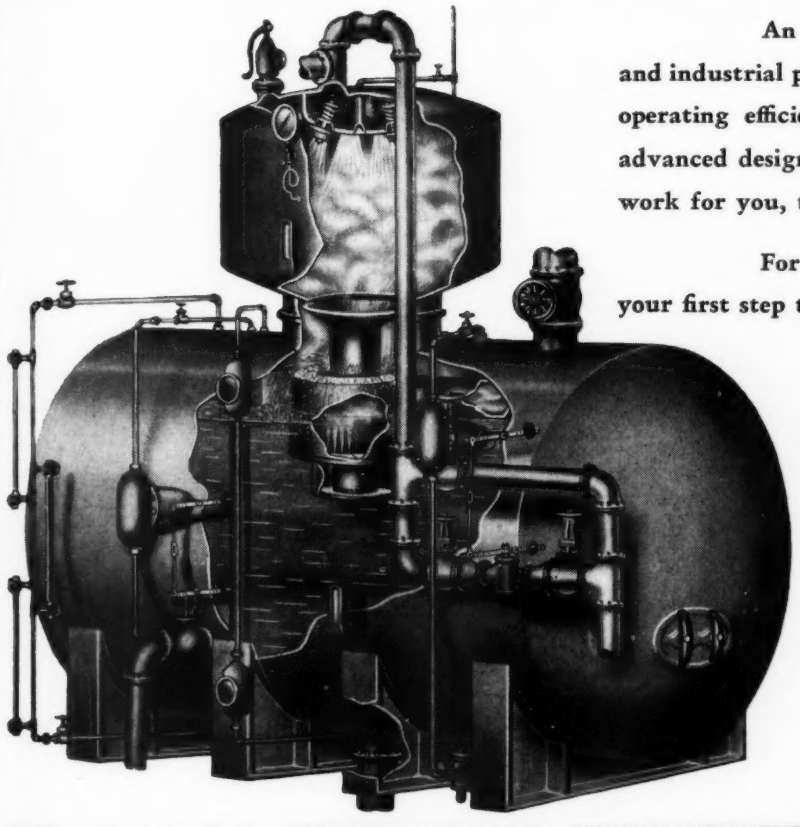
variations, how they work, equipment required, and type of water produced. Advantages of various methods are interpreted in terms of application to specific industries. *Rohm & Haas Co., Resinous Products Division, Dept. CE, Washington Square, Philadelphia 5, Pa.*

AIR CIRCUIT BREAKERS — Bulletin 5107-BR-1 contains four pages of facts, figures, features, and photographs on types KA, KB, KC, and LG Urelite air circuit breakers. There is also information on weather proof and dust tight enclosures, plus applications, specifications, and construction details. *I-T-E Circuit Breaker Co., Dept. CE, 19th and Hamilton Sts., Philadelphia 30, Pa.*

SUPER-SENSITIVE ANALYZER—Four-page pamphlet 501 describes a gas analyzer capable of measuring toxic and hazardous gases in parts per billion. Flow diagrams explains operation of the unit. *Taller & Cooper, Inc., Dept. CE, 75 Front St., Brooklyn 1, N. Y.* ▲▲

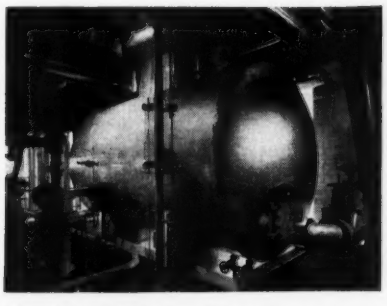
In Deaeration, too

BELCO Builds a Complete Line-

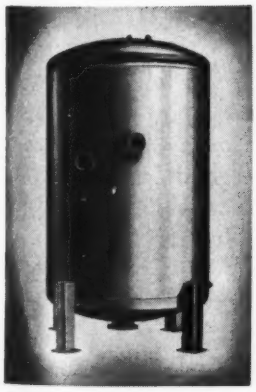


An increasing number of well known utility and industrial plants are using Belco equipment to increase operating efficiency and decrease operating costs. Belco advanced design and application experience can be put to work for you, too.

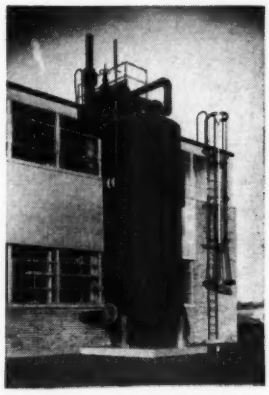
For technical assistance write or call Belco — your first step to lower costs.



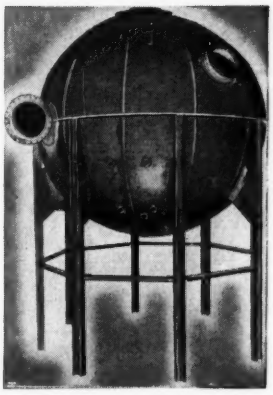
SPRAY TYPE — Belco Deaerator in large eastern oil refinery. Has a capacity of 300,000 lbs/hr.



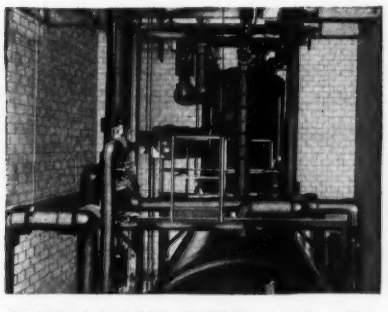
MARINE TYPE—Typical Belco marine heater furnished to shipyards. (Approved by Lloyds of London)



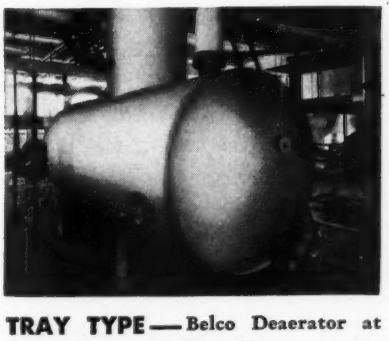
OPEN TYPE—Deaerator at large eastern pharmaceutical plant. Capacity of 80,000 lbs/hr.



VACUUM TYPE — Unit shipped set-up to midwestern utility. Has 150,000 lbs/hr capacity.



SPRAY TRAY TYPE — Belco Deaerator at New York State institution boiler house. Capacity 120,000 lbs/hr.



TRAY TYPE — Belco Deaerator at southern municipality. Has a capacity of 125,000 lbs/hr.

Belco

Boiler Feedwater Heaters • Water Softeners • Filters • Clarators
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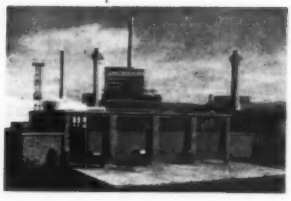
BELCO DESIGNS, ENGINEERS & FABRICATES WATER PROCESSING EQUIPMENT



Atomic Plants

—*Starts on page 38*

tion at Calder Hall, the primary objective is to transfer the enormous quantities of heat released in fission to a boiler, and use the steam for generating electrical energy. Previously, in the production of plutonium for atomic bombs, this heat has been an unwanted by-product. Recent experiments have shown that by using a "fast reactor"—i.e., one in which the neutrons move at the high speeds they possess immediately on release from the nucleus—it is possible to produce a greater quantity of an equally efficient secondary fuel. This process is known as "breeding."

Breeder Systems

An example of a breeder system is a fast reactor charged with plutonium 239 as a fuel and with the reacting core surrounded by a blanket of uranium 238. Neutrons escaping from the core enter the blanket where they transmute the uranium 238 to more plutonium 239. The amount of fresh fuel bred in this way can exceed that consumed in the core of the reactor if care is taken to avoid waste of neutrons. With the new breeder reactors, it is possible to build up stocks of "artificial" secondary fissile materials made from uranium 238 and thorium.

In the application of the atomic "furnace" to steam generation for electric power production, an important item is the heat-transfer medium—which in the case of Calder Hall Plant will be carbon-dioxide gas under pressure. The reactor core will be enclosed in a mild steel shell, screened by a concrete shield. Boilers heated by the "coolant" gas (CO_2) will be placed around the reactor and the superheated steam will be passed to a turbo-alternator of conventional design.

The first unit at Calder Hall will make use of a uranium-graphite pile; later, it is intended to undertake the design and construction of a prototype fast reactor for power production and breeding. But a great deal of research remains to be done with the zero-energy fast reactor now being built at Harwell before the basis for the design of the pure breeder is established.

From the economic aspect, a great deal will depend on reducing the cost of accelerating the chemical process of extraction of atomic fuel from breeder reactors. The Calder Hall power station has an initial advantage in that electricity cannot be debited with the whole of the capital charges, since plutonium for military purposes is to be produced as a by-product.

It has been decided to use graphite-moderated, gas-cooled reactors operating on natural uranium at the Cumberland Atomic Power Plant because this type provides inherent safety and stability, and because the core has a large thermal stability. Heat ratings, however, would be rather modest per ton of uranium, which would mean a rather large capital investment for uranium.

Other disadvantages may be the need for use of pure graphite for the moderator and safety shut-off rods and the difficulty in construction of the pressure shell—the latter being a cylinder approximately 30 feet in diameter.

Reliable operation is expected with a maximum surface temperature of the fuel elements of about 752 F. The gas-coolant circuit is under pressure (perhaps 100 psi). The core design of the reactor has vertical channels, and from the heat transfer and nuclear points of view, the coolant should be helium, carbon-dioxide, or nitrogen. The coolant gas will be circulated 'round the closed coolant circuit by motor-driven blowers, providing a gas outlet temperature of about 662 F. The heat exchangers or steam boilers could be located outside the main biological shield surrounding the reactor itself under these conditions.

Looking Ahead

It may eventually be possible to generate the whole of Great Britain's electric-power requirements by nuclear fuel. This would mean a considerable coal savings, especially since it appears that these requirements are likely to increase to a yearly coal consumption of 63 million tons in the next 15 years. By the end of that period, efficient power breeders might have been developed to the point where they could be built in sufficient numbers to generate all the electricity needed; moreover, by that time, an adequate stock of plutonium would be available to fuel the power breeders.

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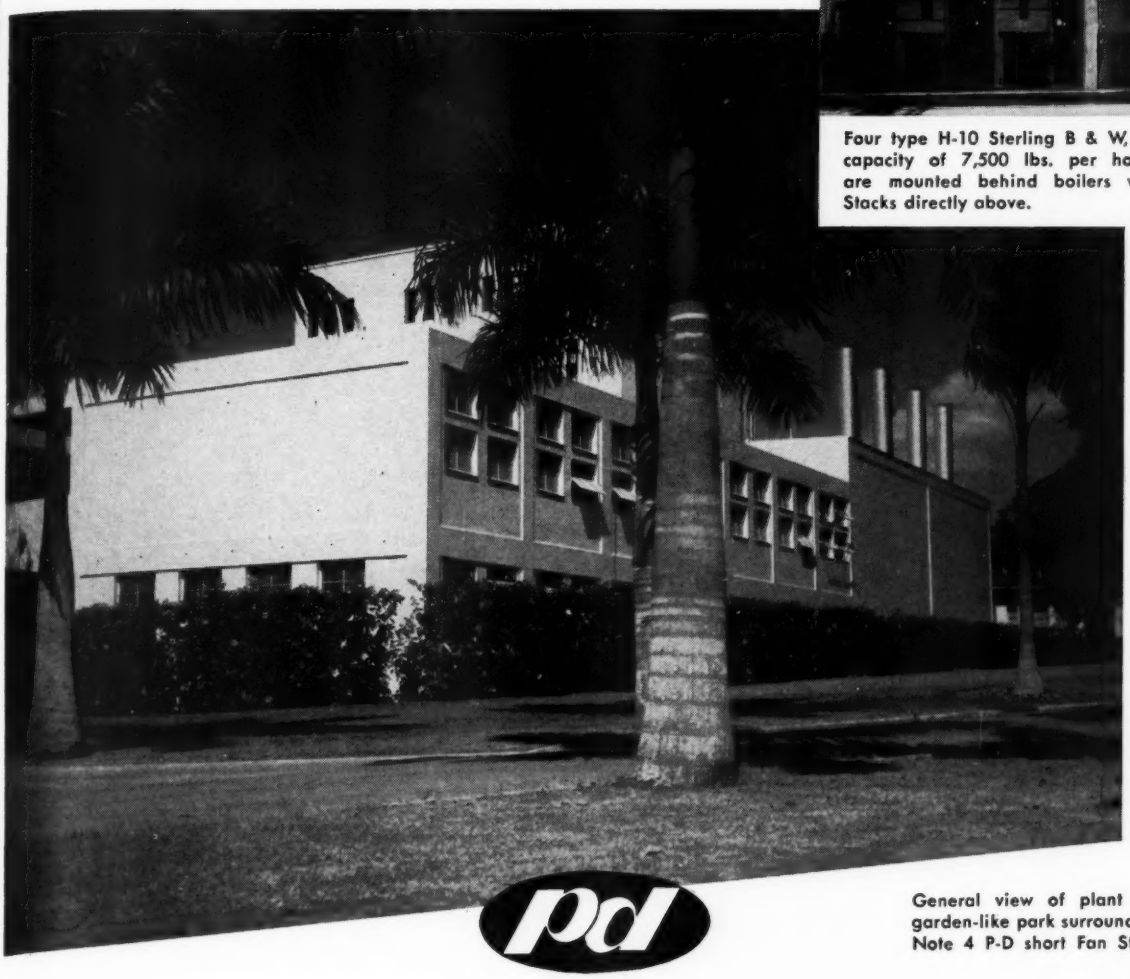
Garden spot for **power...**

Four type H-10 Sterling B & W, Boilers with steam capacity of 7,500 lbs. per hour. P-D Collectors are mounted behind boilers with the P-D Fan Stacks directly above.



General view of plant from garden-like park surroundings. Note 4 P-D short Fan Stacks.

...kept free from flyash with P-D Dust Collectors

A model power plant, set in a garden, was realized by Cerveceria Modelo, S.A., Cotorro, Cuba. This company, a part of the Bacardi interests, determined to maintain a garden-like atmosphere surrounding the plant.

Although boilers are completely automatic, Prat-Daniel design 6HC horizontal Dust Collectors were installed to collect flue gas residue resulting from oil-firing. P-D Fan Stacks insured adequate, constant draft through boiler and collectors. Capacity of these collectors at 580°F. is 4860 CFM at 1.75 in WG resistance.

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PRAT-DANIEL CORPORATION

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POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

Witness

—Starts on page 48

ciates in litigation or to his client.

In an extensive law suit, involving the sum of $100 million, the author was an expert witness for the defendant. He was approached by members of four independent law firms to serve various plaintiffs of the same case. In his necessary refusal to serve with these plaintiff factions, he parried their offers in such a manner that not one of them suspected he was already employed as the defendant's expert witness and actually had conducted extensive research on the subject matter.

The surprise to the opposing counsel of an expert witness' appearance on the witness stand sometimes carries considerable advantage. This is particularly true when insufficient time is available for the opposing counsel to ferret into the expert witness' biography, publications, and research studies, some of which may closely parallel the nature of the current litigation.

Cross-Examination

As much information as possible should be determined about the characteristics and behavior of each opposing expert witness. Their strong and weak points should be examined—including knowledge relating to other cases on which they have served, whether they have conducted research along the lines of the current case, what publications of the opposing expert witnesses may be found in the literature, and whether any of these studies and publications pertain more or less directly to the case at issue.

In addition, the hypothetical lines of attack by the opposing counsel should be considered and the theory on which the opposition may conduct its case given specific attention. The objectives are to anticipate the probable lines of cross-examination by opposing counsel. With speculative information of this character at hand, the expert witnesses may formulate hypothetical questions of cross-examination. The more that this phase of preparation can be indulged in, the better qualified become the training and specialized education of the expert witnesses—not only to anticipate well in advance many of the probable questions on cross-examination, but also, by giving (without appearing smug) clever and astute answers, thus often leaving the opposing councel in a state of apparent confusion.

During periods of preparation and practice in presenting testimony, efforts by associated expert witnesses and lawyers to disconcert their witness on the theory he propounds and on his various statements, comprise an excellent technique for revealing whatever weaknesses he may possess. In these practice periods all concerned should understand that the attempt of colleagues to test the expert witness' accuracy, composure, and ability to think under adverse and annoying circumstances is all in the spirit of cooperative training.

Since an expert witness may be subjected to cross-examination over a very broad engineering or scientific area, he must be prepared and ready to make computations, if called on, in remote perimeters of the field of engineering or science relating to the case. Where such computations are lengthy, he may proceed in a number of directions.

Involved Calculations

One is to carry out his calculations, step by step, explaining to the court and jury as he goes along, provided he can arrive at an answer with assurance. Or, he may request a recess of not over 15 to 20 minutes for the purpose of making his computations during this interval.

On the other hand, if the problem requires a considerable length of time, the suggestion of working it out during the evening and presenting it before the court the following morning may appeal to the judge. The expert witness may be directed to follow such a course. This plan possesses the advantage of providing ample time to do a thorough job and to tie in the results effectively with the trend of the testimony.

Hence, during the preparation of expert witnesses for both direct and cross-examinations, the probabilities of the occurrence of such physical relationships appearing as questions which require definite computations should be explored and seriously entertained beforehand.

Engineering Proof

For example, in a case involving a collision between automobiles, especially where a fatality resulted, a question relating to the stopping distance of a rapidly moving vehicle on dry, wet, or icy roadways may be propounded for calculation.

Or in the short circuit of a transformer, where burning of the insulating and cooling oil within the tank set off a chain reaction of costly fires, a question on cross-examination might relate to the magnitude of the short circuit current, the calculation of the temperature rise of the oil caused by the short circuit, or other associated questions which necessitate a knowledge of the fundamental transformer relationships and their mathematical solutions.

Finally then, after the expert witnesses, by their self-imposed cross-examinations, have devoted detailed attention to developing fully all phases of their own theory and its minor variations, as well as the propounding and answering of questions predicated on the hypothetical or anticipated theories of the opposing side, they are ready for court.

AFTER-COOLER FOR NEW DETROIT FOUNDRY

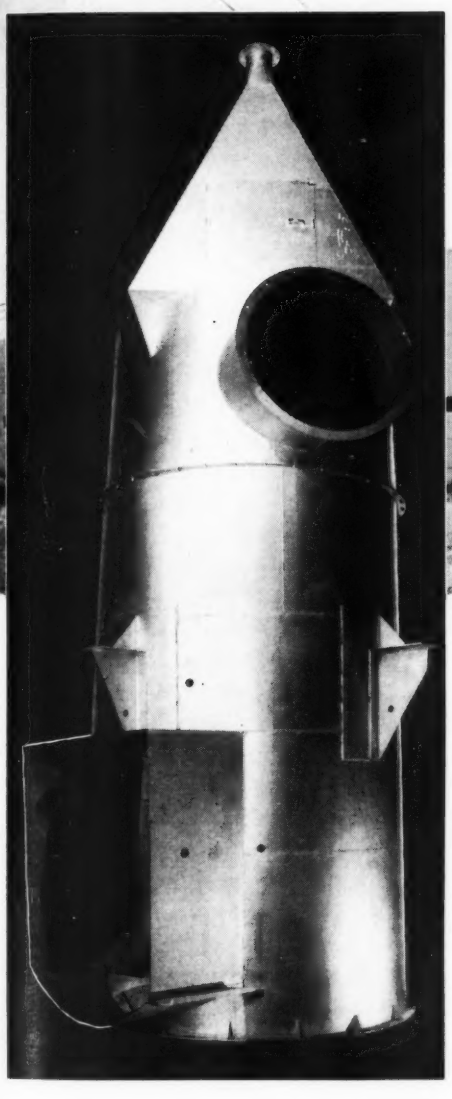


Photo at left shows one of two cooling chambers, integral components of vortex type dust collectors. Special design by Grindle Corporation eliminates dust, fumes, general smoke nuisance from expanded cupolas and stacks of major Detroit automobile manufacturer.

After-cooler pictured above is typical of heavy *precision* weldments manufactured by Foster. New building has heavy duty over head crane facilities; houses new equipment for shearing, burning, bending, braking, forming, annealing, sand-blasting.

Raw materials from nearby Gary-Chicago mills; deliveries by motor freight, railroads, barges via Illinois and St. Lawrence Waterways.

Tho costs are moderate, fine quality and agreed delivery are sole standard at Fosters.

THE **foster** COMPANY ST. JOSEPH, MICHIGAN

Continuous Conveyors

—*Starts on page 58*

pling is a water-cooled, eddy current clutch. This drive insures the essential requirements of slow acceleration. If an emergency within the mine is accompanied by a failure of the main hoist, the coupling can be lightly energized so as to hold the speed of the belt slow enough to allow the men to ride it as an escape route.

How well these heavily stressed belts will stand up in service has not yet been proven. It is vital that the transition from the trough to the flat, as the belt approaches the drive pulley, be made gradual through the use of transition idlers. If a vertical curve is involved, its radius must be far greater than designers are accustomed to. The curve gives the edges of the belt a different length from the mid-section, and because of the high modulus of the steel cables, a bad distribution of tension across the belt width may otherwise occur.

Advantages of Longer Spans

If belt life is determined by the life of the cover, as it is in most industrial installations, longer spans are advantageous. The principal cause of cover wear is load impact, and the frequency of impact is inversely proportional to the distance between centers. So also are the frequency of bends around the terminal pulleys and contact of the belt with the brushes or scrapers.

To what length, then, can a single span belt conveyor be extended? This is an interesting problem. Let us consider a 30-in. conveyor at 300 fpm for 200 tons of coal per hour, with a wire cable belt rated at 3000 lb per inch of belt width, and about ten miles between centers.

Since the size, speed, and capacity of this belt are the same as the National Mines conveyor, the power readings for that installation can be extended as shown in Fig. 1. The gravity assist has been deleted. Using this graph, we find that the power for moving the 10-mile belt will approximate 430 hp, and that required to move the load will be approximately 270 hp. The total power required will therefore be 700 hp, and effective tension will be:

$$\frac{700 \times 33{,}000}{300} = 77{,}000 \text{ lb}$$

or 2570 lb per inch of belt width.

Can this effective tension be maintained if the conveyor is extended still further? It is common practice with chain conveyors, such as foundry flask carriers, to use boosters that engage the chain along the loaded run. A booster-driven conveyor can be extended to any desired length — the head sprocket merely becoming an idler. Let us apply the booster idea to the belt conveyor.

Assume ten boosters along the ten mile carrying run, each 500 feet long and spaced 5000 feet apart. Figuring the load at 200 tons per hour, and the total weight of the belt itself at 23 lb per foot, the 500-ft loaded section against which the booster functions will weigh 22,500 lb. Using the friction coefficient for rubber against rubber at the low figure of 0.33[1], each booster will thus transmit an assist of 7425 lb. The power required for 5000 feet of loaded belt behind each booster is about 90 hp, Fig. 1, or a pull of about 10,000 lb. Thus the boosters relieve the main drive of 74 percent of the operating load, noting the above 2570-lb tension figure, and we have doubled the conveyor length by using boosters every 5000 feet without approaching the belt's tension rating.

We must, however, check the effectiveness of the boosters with the belt empty. The embedded-cable carcass of the belt weighs 16.34 lb per foot, and the covers weigh 6.7 lb per foot. Thus the total weight is 23 lb per foot, or 11,500 lb for 500 feet. The maximum assist of each booster against the empty belt is 3795 lb. Again referring to Fig. 1, we find the power required to pull the 5000 feet of empty belt behind each booster is 50 hp. Thus, the pull back of each booster is:

$$\frac{50 \times 33{,}000}{300} = 55{,}000 \text{ lb}$$

Subtracting the maximum assist of each booster from this figure, we get 1705 lb. Thus 17,050 lb (1705 x 10) remain to be taken care of at the head pulley, leaving ample margin for bringing the belt up to speed.

Of course there are limitations. The booster effect will be reduced if there are gaps in the load stream, or if the underside of the belt should become damp. If, in an emergency, the conveyor becomes stopped while fully loaded, the belt sag between idlers might make it necessary to jettison part of the load.

One-Hundred Mile Conveyors

We have seen that by spacing boosters every 5000 feet along the run of a 10-mile conveyor, the power requirement at the head is reduced by 74 percent. Going even further, let's consider a 100-mile, single-flight conveyor. With lengths this long, we must take care of 100 percent of the pull throughout both the carrying and return runs. We will space the boosters 2500 feet apart, with their return runs resting upon the return runs of the

[1]The coefficient of static friction, as between rubber and rubber, varies with the specific gravity, the density, and the make-up of the rubber compound. It also varies if the surfaces are damp, dirty, or dusty. Clean rubber on rubber has a coefficient of 0.55 to 0.78, but in practice it is usual to take the figure as 0.35 or 0.36.

main belt. The tractive pull of the boosters readily takes care of the requirement of the loaded run, and the question becomes whether or not it can also handle 100 percent of the return run pull. If the booster belt has a steel cable reinforced carcass to provide the weight necessary for traction, the total return pull of 3300 lb per 2500 feet is readily absorbed. Each of the 200 boosters provides a total pull of 5500 pounds, calling for a 50 hp motor. The total power requirements for a 100-mile conveyor would therefore be 10,000 hp. With duplicate interlocked drive groups at both ends, few complications would be met in making the conveyor reversible.

Comparisons

It is interesting to compare this belt system with a possible competitor—the hydraulic pipeline. R. W. Dougherty of the U. S. Bureau of Mines made an extensive survey of the possibilities of hydraulic transportation of coal from data available as of 1951. Basing his figures on a 100-mile pipeline handling 200 tons of coal per hour, he estimated the total cost, including labor, materials, right-of-way, and station sites would be $10,071,000. The investment for a belt system would be much higher, since the belts alone would cost more than $15,000,000.

Although the belt conveyor is higher in initial cost, it can convey coal sizes up to 10-in. lump with minimum breakage, while the coal for the pipeline must be crushed. Also, the belt line eliminates the problems of water storage, de-watering at the discharge point, and high pipeline and pump maintenance involved in pumping 150,000 gallons of coal-water mixture 24 hours per day. Finally, the belt conveyor is available for transportation in either direction, which could be a major factor.

Rail freight rates vary. A fair average is $2.00 to $2.20 per ton for a 100-mile haul. The hydraulic system power cost (at $0.012 per kw-hr) would be $2876 per 5000 tons per 24 hrs, or $0.575 per ton per 100 miles. The belt system power cost would be $2145 per 5000 tons per 24 hrs, or $0.429 per ton per 100 miles. It should be noted, however, that the power is only part of the total cost. Mr. Dougherty estimated that the total cost for the hydraulic system would be about $1.91 per 100 ton-miles. If the useful life of the steel cable reinforced belt is as good as we have every reason to expect, the total operating cost for the belt system should be substantially lower than that figure.

A single-flight conveyor many miles in length is an interesting possibility that may someday be realized. Veteran engineers can recall the days when the suggestions that ore could be unloaded from vessels at 4000 tons per hour, that bulk cement could be moved distances of 5000 feet or more by air, or that coal could be picked up and moved by motorized equipment at 50 tons per load were only possibilities that have since become realities. ▲▲

Wire Thread Inserts

—Starts on page 55

wood supporting members. If it is to be installed elsewhere, a wooden block is placed inside the panel to receive the insert.

Galvanic Action

Stainless-steel inserts also are being used to prevent galvanic action between dissimilar metals. An example is the portable resistance-welding guns manufactured by Progressive Welder Sales Co.

Welding current is supplied to the welding gun yoke made of a special aluminum alloy. The current follows a path from the cable attaching lug to the moving tip holder through a jumper made of electrolytically pure copper. Because of the high welding currents, 5000 to 10,000 amperes at 5 to 10 volts, galvanic action might occur where the copper jumper is secured to the aluminum-alloy yoke.

To preclude formation of an insulating layer of copper and aluminum oxides, an extremely tight assembly is required. When reinforced with helical wire inserts, threads tapped directly into the comparatively soft aluminum alloy provide thread loading strengths substantially higher than unprotected threads, thus allowing higher installation torque.

Electrical Connections

The Tocco Division of the Ohio Crankshaft Co. reinforces holes tapped in copper conductor plates and bus bars with stainless-steel wire thread inserts. The higher thread loading strengths obtained with insert-protected threads permit tight cap screw connections between electrical conductors and the company's induction blocks.

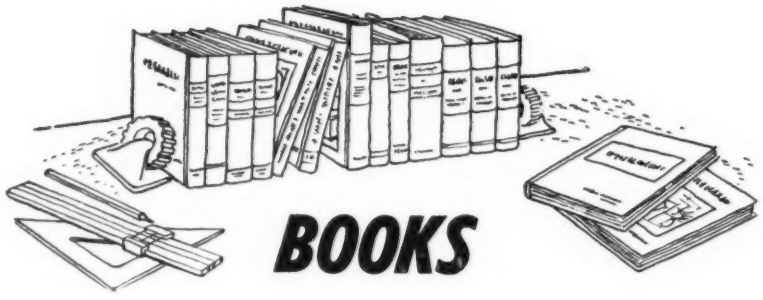
The frequent interchange of induction blocks to satisfy production requirements, and the many cycles of cap screw insertion and removal, would cause excessive wear if threads in the soft copper were unprotected. Each set of copper transformer outlet plates uses from 12 to 16 wire thread inserts.

Automatic Signal Division of Eastern Industries, Inc., achieves three major design advantages by using inserts in the tapped holes of its plastic terminal boards. In addition to strengthening the plastic threads and providing protection from wear, the phosphor-bronze inserts provide electrical connections through the panel, and the "tangs" of the inserts are bent to form soldering lugs for wires leading to electronic units. ▲▲

consulting engineers' calendar

Date	Sponsor	Event	Location
June 20-24	American Society of Mechanical Engineers	Semi-annual Meeting	William Penn Hotel Pittsburgh, Pa.
June 20-25	American Institute of Chemical Engineers	Nuclear Engr. Conference	University of Mich. Ann Arbor, Mich.
June 21-25	American Institute of Electrical Engineers	Summer General Meeting	Los Angeles, Calif.
June 28-30	American Society of Heating and Ventilating Engineers	Semi-annual Meeting	New Ocean House Swampscott, Mass.
July 13-15	Western Plant Maintenance Show	Conference and Exposition	Pan Pacific Bldg. Los Angeles, Calif.
Sept. 8-10	American Society of Mechanical Engineers	Fall Meeting	Hotel Schroeder Milwaukee, Wisc.
Sept. 12-16	American Institute of Chemical Engineers	Fall Meeting	Colorado Hotel Glenwood Springs, Colo.
Sept. 12-16	Illuminating Engineering Society	National Technical Conf.	Chalfonte-Haddon Atlantic City, N. J.
Sept. 15-17	Compressed Air and Gas Institute	Meeting	Skytop Lodge Skytop, Pa.
Sept. 15-20	Instrument Society of America	International Instrument Exp.	Convention Hall Philadelphia, Pa.
Sept. 21-23	Society for Experimental Stress Analysis	Annual Meeting	Bellevue-Stratford Philadelphia, Pa.
Sept. 27-29	American Institute of Electrical Engineers	Petroleum Conference	Mayo Hotel Tulsa, Okla.
Oct. 4-6	National Electronics Conference	10th Annual Conference	Hotel Sherman Chicago, Ill.
Oct. 5-7	American Institute of Electrical Engineers	Middle Eastern Dist.	Abraham Lincoln Reading, Pa.
Oct. 11-15	American Institute of Electrical Engineers	Fall General Meeting	Conrad Hilton Hotel Chicago, Ill.
Oct. 18-22	American Society of Civil Engineers	Convention	Hotel Statler New York, N. Y.
Oct. 25-27	American Institute of Electrical Engineers	Machine Tool Conference	Hotel Statler Detroit, Mich.
Nov. 10-12	Industrial Management Society	Management Clinic	Hotel Sherman Chicago, Ill.
Nov. 28-Dec. 3	American Society of Mechanical Engineers	Annual Meeting	Hotel Statler New York, N. Y.
Nov. 29-Dec. 3	1st International Automation Exposition	Exposition	242nd C. A. Armory New York, N. Y.
Dec. 12-15	American Institute of Chemical Engineers	Annual Meeting	Hotel Statler New York, N. Y.

PROFESSIONAL LISTINGS



BOOKS

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PROFESSIONAL INCOME OF ENGINEERS—1953, Engineers Joint Council; 32 pages; $2.00. This publication is the final report of the survey conducted in 1953 by the EJC Special Surveys Committee headed by Maynard M. Boring of General Electric Company. The report contains information covering the professional income of about 72,000 engineers employed in industry, government, and engineering education. This represents about 22 percent of the total number of engineers estimated to be employed by industry, engineering, and education. The income of engineers employed in industry is presented by the type of industry in which employed. This is a departure from practices employed in earlier surveys which presented data by engineering specialties.

This report provides the most comprehensive study of engineering professional income since "The Engineering Profession in Transition," which was published in 1947. As such, it will be of great interest and value to all concerned with questions of engineering income.

A POLICY FOR SCIENTIFIC AND PROFESSIONAL MANPOWER; Columbia University Press; 197 pages; $3.50. The National Manpower Council—a group of leaders in industry, labor, education, and public service from all parts of the country, pointed out in the Spring of 1953 that America's limited resources of highly trained personnel are not being utilized as effectively as they could. To contribute to a better understanding of manpower utilization problems and practices and of the ways for securing the more effective use of scientific and professional personnel, the Council brought together sixty-six experts from all parts of the United States for a five-day conference.

Engineering, medicine, and teaching are the three professional fields upon which the Conference centered its attention. This volume, prepared by Dr. Henry David, Executive Secretary of the Council, presents new, significant material of practical import for everyone concerned with the effective utilization of highly trained manpower. It contains accounts of the authoritative discussions of the Conference as a whole and of its special Working Groups on engineering, medicine, and teaching. It makes available the paper prepared for the Conference by a number of distinguished experts.

The summary of the Conference findings by Dr. Eli Ginzberg, Director of Research for the Council, is particularly valuable, for it develops six major approaches for solving problems of more effective manpower utilization.

DIESEL AND HIGH COMPRESSION GAS ENGINES—FUNDAMENTALS, by Edgar J. Kates; American Technical Society; 396 pages; $5.50. The author, Edgar J. Kates, is an engineer well-known in the diesel engine field. He is a fellow of the American Society of Mechanical Engineers and has served as chairman of the Oil & Gas Power Division of that Society. In this book Kates has provided a middle ground which enables both the technical and non-technical reader to gain a basic understanding of the principles, construction, and operation of the diesel and the high compression gas engine. Since a considerable amount of this book is given to the high compression engine, it will be of value to engineers investigating this type of prime mover.

TITANIUM AND TITANIUM ALLOYS, by John L. Everhart, Reinhold Publishing Corporation; 184 pages; $3.00. This book is intended for the engineer or designer interested in the possibilities of applying titanium in the solution of his metallurgical problems. Only sufficient information is included on production to indicate the effects of melting methods on the properties. The properties of pure titanium are covered briefly merely to furnish a background for a discussion of commercial materials.

Subjects covered include heat treatment, forming and fabricating, joining, machining and grinding, cleaning and finishing, and applications. The book has done a very good job in bringing together information now available only through scattered transactions of a number of societies and technical articles in business publications.

MODERN LABOR ECONOMICS, by Pearce Davis and Gerald J. Matchett; The Ronald Press Company; 700 pages. This new volume covers the entire range of labor and management objectives, issues, and problems. By focusing on collective bargaining as their central theme, the authors are able to coordinate and integrate the many facets of union-management relations. Individual bargaining is fully explored as an alternative to collective bargaining. The volume explains and analyzes in historical perspective such key subjects as growth of unions and collective bargaining, labor and management objectives and organization, collective and individual agreements, the role of government in labor-management relations, wage structures, the economics of labor demand and supply, wage differentials, wage theory, and issues of public policy. Included are excerpts from up-to-date labor-management agreements, union constitutions, and other labor and management documents.

AUTOMATIC CONTROL OF HEATING AND AIR CONDITIONING, by John E. Haines; McGraw-Hill Book Company; 354 pages; $6.75. This book is devoted solely to automatic control as applied to heating and air conditioning. It first introduces basic principles, then illustrates them by describing construction and characteristics of representative control devices. Finally, the author tells how to combine individual control devices into control systems. After a thorough explanation of electric-control circuits and pneumatic-control circuits comes a description of various representative types of units used in these two systems.

The author gives special attention to radiant panel heating and developments in that field. Typical control systems for panel heating are described.

consulting engineer

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